REPORT

PROJECT FOR THE ANALYSIS OF TECHNOLOGY TRANSFER

Quarterly Report #1 – 1970
1 January 1970 – 31 March 1970
Contract NSR 06-004-063

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DENVER RESEARCH INSTITUTE
UNIVERSITY OF DENVER

This report – Quarterly Report #1 for 1970 – presents the results of three months of research on technology transfer conducted by the Industrial Economics Division of the University of Denver Research Institute (DRI).

Material presented in this report was gathered and analyzed as a part of the Project for the Analysis of Technology Transfer (PATT). PATT was established in November 1967 to provide a better understanding of the technology transfer process by examining nonspace applications of NASA-developed technology. To achieve this goal PATT has the following objectives:

(1) To operate a Technology Transfer Data Bank consisting primarily of information on the characteristics of users of NASA's Tech Brief-Technical Support Package Program.

(2) To document actual and potential cases of transfer of space-related technology to secondary uses.

(3) To suggest for NASA's consideration programs or mechanisms to improve the effectiveness and to reduce the costs of NASA's technology transfer activities.

(4) To maintain contact with sources of technology, with channels of technological communication, and with users of technology in order to stay in touch with developments affecting performance of these participants in the technology transfer process.

(5) To maintain awareness of past and on-going research contributions to the understanding of the technology transfer process, and to contribute to this knowledge base.

This report summarizes progress made during the period January 1 – March 31, 1970, in achieving these objectives, and briefly discusses future activities. It builds on data presented in previous PATT reports as well as on results of other DRI technology transfer research.

QUARTERLY REPORT #1 - 1970

PROJECT FOR THE ANALYSIS OF TECHNOLOGY TRANSFER

1 January 1970 - 30 March 1970

Contract NSR 06-004-063

- Prepared for -

National Aeronautics and Space Administration

- Prepared by -

Industrial Economics Division
Denver Research Institute
University of Denver

May 1970

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REPORT HIGHLIGHTS

- During the first three months of 1970, PATT personnel documented 40 cases in which NASA developed technologies have been transferred to other sectors of the U.S. economy (Section I and Appendix A).

- A comparison of persons requesting Technical Support Packages (TSP's) from NASA field centers with those ordering TSP's from the CFSTI (Clearinghouse for Federal Scientific and Technical Information) showed that the two groups (a) differ substantially in terms of the organizations by which they are employed and the technical subject matter they requested; and (b) are nearly identical in terms of the benefits they associate with TSP use, difficulties encountered, and overall TSP ratings (Section II).

- Major progress occurred during the quarter in developing a comprehensive filing system which (a) documents transfers of NASA-developed technology; and (b) provides quick access to all known transfers by industry, firm size, location, technical subject matter, and application area (Section III).

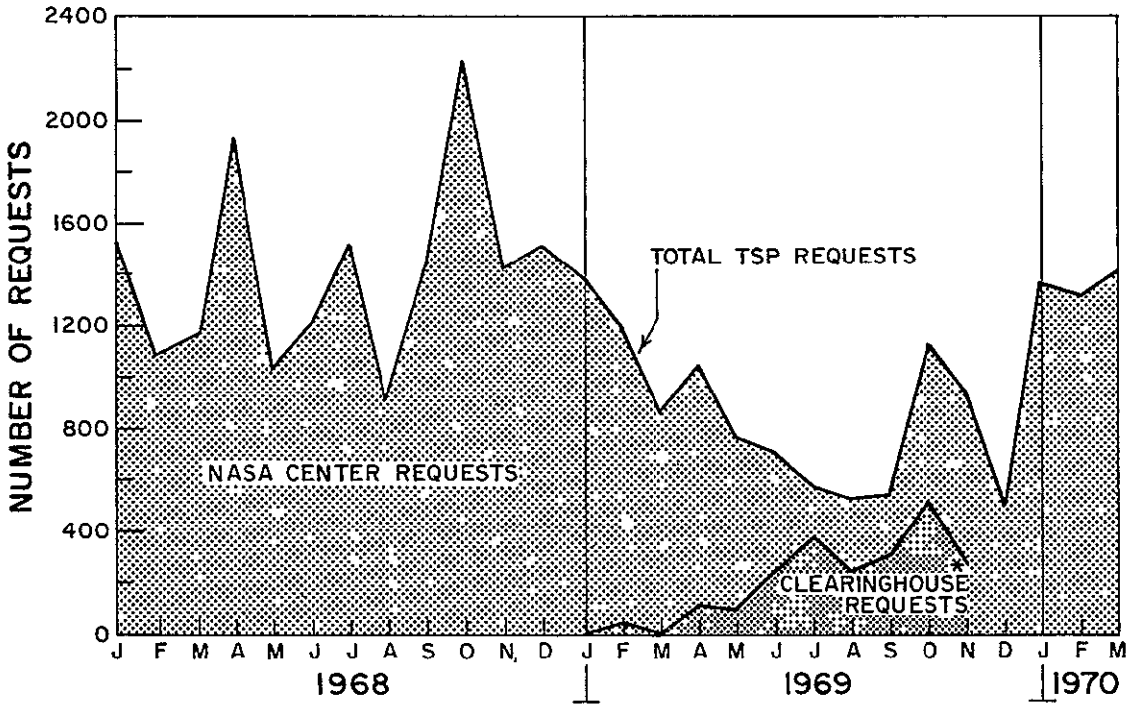
SECTION I. PATT FIRST QUARTER 1970 RESEARCH ACTIVITIES

PATT research activities conducted from January through March 1970 are reviewed in this section.

Tech Brief-Technical Support Package Program

The volume of requests for Technical Support Packages appears to be picking up again after going through a slump in mid-1969 (see Figure 1).

FIGURE 1. TSP REQUESTS FOR TECHNICAL SUPPORT PACKAGES, BY MONTH, JANUARY 1968 - MARCH 1970



Note: Data on requests to the Federal Clearinghouse of Scientific and Technical Information are not available beyond November 1969.

The number of TSP requests for each NASA center, for 1969 and the first quarter of 1970, are shown on Table 1. For 1969, Marshall Space Flight Center generated 49 percent of all TSP requests (see Table 1).

TABLE 1. REQUESTS FOR TECHNICAL SUPPORT PACKAGES, BY NASA CENTER, JANUARY 1969 - MARCH 1970

	1969												1970			
	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL
Ames Research Center	45	26	21	18	24	64	15	18	10	49	46	18	39	74	64	531
Argonne National Laboratory	0	0	0	14	1	1	5	3	5	1	3	0	0	0	0	33
Electronics Research Center	21	12	27	25	12	3	24	9	16	9	5	0	0	0	0	163
Flight Research Center	4	5	2	3	1	2	1	0	0	1	0	0	2	1	0	22
Goddard Space Flight Center	125	51	125	61	43	50	39	43	32	103	60	53	59	76	201	1121
Headquarters	0	11	25	16	2	7	2	3	3	18	26	6	0	0	39	158
Kennedy Space Center	18	43	0	0	5	0	2	7	9	43	25	9	72	55	11	299
Langley Research Center	1	2	0	15	4	6	7	2	1	3	5	9	92	12	21	180
Lewis Research Center	129	217	64	78	89	61	68	58	102	203	94	62	129	124	113	1591
Manned Spacecraft Center	98	84	60	53	49	58	80	74	76	200	70	54	124	178	216	1474
Marshall Space Flight Center	593	568	454	616	445	400	279	273	238	429	240	188	459	530	489	6201
NASA Pasadena Office	1	9	1	5	15	39	29	12	15	37	35	0	0	0	0	198
Space Nuclear Propulsion Office	3	22	7	104	21	3	1	1	1	3	285	38	315	182	56	1042
WSO	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Jet Propulsion Laboratory	58	31	38	47	56	12	15	17	15	33	30	64	67	97	48	628
Other	0	0	1	0	1	0	1	3	13	3	0	0	0	0	0	22
Total	1096	1081	826	1055	768	706	568	523	536	1135	924	501	1358	1329	1258	13,664

TABLE 2. 1969 TSP REQUESTS BY YEAR OF PUBLICATION

Year Tech Brief Published	Number of TSP Requests	Percent of TSP Requests
1969	1,614	16.7
1968	4,367	45.0
1967	2,404	24.8
1966	1,013	10.5
1965 & earlier	296	3.0
Total	9,694	100.0%

As PATT continues to monitor the Tech Brief-TSP program, a number of user behavior patterns have been identified. For example, the volume of requests for TSP's lag substantially behind the issuance of new Tech Briefs. To illustrate, Table 2 shows the number of TSP requests received in 1969 distributed according to the year of publication.

The role of handbooks and manuals in generating requests is also becoming more evident. The 17 such documents now in the system have generated 25 percent of all requests received since the inception of PATT in November 1967. These TSP requests also find application as evidenced by the fact that 25 percent of all cases of technology transfer in the PATT files involve those manuals and handbooks.

The ten TSP's most frequently requested during the first quarter of 1970 are listed in Table 3.

TABLE 3. TEN MOST FREQUENTLY REQUESTED TSP'S DURING THE FIRST QUARTER, 1970

TSP Number	Request Frequency	Originating Center	Title
67-10510	109	MSC	Probabilistic Approach to Long Range Planning of Manpower
68-10069	106	Goddard	Principles of Optical-Data Processing Techniques
69-10009	88	Marshall	Gun Facilitates Adhesive Bonding of Studs to Surface
69-10705	87	SNPO	Nuclear Physics Made Very Very Easy
68-10235	84	Langley	Tube Swaging Device uses Explosive Force
68-10080	78	Marshall	Numerical Control Machine Data Manual
68-10073	70	Marshall	New Microelectronic Power Amplifier
69-10021	56	Marshall	Fifth-Wheel Fork Truck Adapter
67-10348	53	SNPO	Computerized Parts List System Coordinates Engineering Releases, Parts Control, and Manufacturing Planning
69-10221	52	MSC	Multiple-Mask Chemical Etching
All Others	2252		
Total	3035		

Telephone Interviews. During the past three months, 95 telephone interviews were completed. The results of 36 of these interviews are presented in Appendix A of this report. Shown below is a summary of all interviews. Table 4 reflects the increasing importance assigned to following up leads, other than leads derived from the Tech Brief/TSP program, where NASA technology may have been applied.

TABLE 4. 1970 FIRST QUARTER TELEPHONE INTERVIEWS

Source of Lead for Follow-up	Actual or Potential Transfer	No Transfer Occurred
Tech Brief/TSP	33	47
Clippings	7	7
Totals	40	54

Since the inception of PATT, there have been 631 contacts with potential or actual users of NASA technology and recontacts of 50 individuals (see PATT Quarterly Report No. 7 for a summary of the recontact program). These 631 contacts have resulted in a total of 540 written cases (plus the 50 write-ups resulting from the recontacts). At the present time, the results of interviews where the technology was not applied, or where there are no plans to apply it in the immediate future, are not presented in written form.

Other PATT Activities

Technology Transfer Example Files. Progress was made in meeting the goal of having a comprehensive data bank of technology transfer examples. A system for retrieving and analyzing information in the files has been designed and is discussed in more detail in Section III of this report. Sample files have been prepared and reviewed by the NASA Technology Utilization Division.

Technology Transfer Library and Bibliography. As of the end of March 1970, over 1,600 documents were catalogued in the PATT library. A revised bibliography containing 60 abstracts of key literature and technology transfer is ready for printing, and should be available for distribution in the summer of 1970.

Technology Transfer Seminar. A report, entitled "The Environment and the Action in Technology Transfer: 1970-80," was distributed in March 1970.

NASA-Related News Clippings. Between 50 and 100 clippings are received each week, and these are monitored and categorized. The primary objective in screening the clippings is to identify probable cases of technology transfer. As these are identified, follow-up interviews are conducted and, if appropriate, written cases are prepared.

SECTION II. A COMPARISON OF TWO TSP DISTRIBUTION METHODS

PATT research on TSP uses during the first quarter of 1970 focused primarily on the following question: How do persons requesting TSP's from NASA field centers compare with persons ordering TSP's from the Clearinghouse for Federal Scientific and Technical Information (Clearinghouse)? This question arose in connection with a recent major review of TSP distribution methods. That review was triggered by a substantial downward trend in the 1969 TSP request frequency (see Figure 1 in Section I). During the first nine months of 1969, TSP's associated with newly published Tech Briefs were distributed exclusively through the Clearinghouse. The Clearinghouse not only charged $3.00 for each TSP requested, but it also added a new link between requestors and NASA center personnel. Previous to 1969, persons obtained most TSP's free of charge from NASA centers and had access to center personnel. Since September 1969, TSP's have been distributed partly by NASA field centers and partly by the Clearinghouse.

Of particular interest in this study, therefore, was the need to determine how the Clearinghouse method affected the occurrence and absolute number of technical impacts and financial gains associated with TSP uses. If it produced proportionately more technical or financial benefits than the NASA center distribution method, then such gains could offset the overall downward trend in TSP request frequency.

Procedure

Data relevant to the two requester groups were drawn from 1,331 TSP request letters and returned questionnaires. Of those cases, 1,094 (78.3 percent) involved persons who had requested TSP's from NASA field centers. The remainder had ordered TSP's from the Clearinghouse.

The two groups were compared on the following items: organizational and professional characteristics; technical subject areas of interest; sources used to learn about specific TSP's; benefits derived from TSP use; difficulties encountered in applying TSP information; and overall TSP ratings.

The Chi Square statistical test was used to determine the extent to which observed differences between the two groups could have occurred by chance alone. A "substantial difference" was defined as one where observed differences could be accounted for by chance alone no more than five percent of the time. All other differences were defined as areas of "substantial similarity."

Findings

NASA center requesters differed substantially from Clearinghouse requesters in terms of:

- Occupations, educational backgrounds, and incomes.
- Sizes and industrial classifications of organizations.
- Technical subject areas of interest.
- Sources used to learn about specific TSP's.
- Professional benefits derived from TSP uses.

The two groups were substantially the same, however, in the important areas of:

- Technical results and financial benefits associated with TSP uses.
- Difficulties reported in using TSP's.
- Overall TSP ratings.

The following discussion specifies the nature of these differences and similarities.

Areas of substantial difference. Proportionately more Clearinghouse requesters worked for large manufacturing organizations (Table 5).*

TABLE 5. CHARACTERISTICS OF REQUESTERS' WORK ORGANIZATIONS (IN PERCENT)

Requesters' Organizational Characteristics	TSP Distribution Method	
	NASA Centers (N = 1,094)	Clearinghouse (N = 237)
Size		
Fewer than 500 employees	52	39
500 or more employees	48	61
Industry		
Manufacturing	53	73
Service	10	15
Government	6	4
Other (e.g., teacher, lawyer, consultant)	31	8

* For ease of interpretation, all tables in this section are presented in percentage form. Tables showing substantial differences (10 percent or greater) between groups have Chi Square values statistically significant at the .05 level or less.

While these observed differences are sizeable, they are not surprising. Larger manufacturing firms, unlike many smaller organizations, frequently have the internal mechanisms (e.g., libraries) better capable of monitoring Clearinghouse publications, reviewing large quantities of Tech Briefs, and handling the paper work and payments involved in obtaining documents from the Clearinghouse.

NASA center requesters tended to report lower incomes and less formal training. These differences were related, at least partially, to the fact that proportionately more Clearinghouse requesters were managers (Table 6).

TABLE 6. PROFESSIONAL CHARACTERISTICS OF TSP REQUESTERS (IN PERCENT)

Requesters' Professional Characteristics	TSP Distribution Method	
	NASA Center (N = 1,094)	Clearinghouse (N = 237)
Education		
Less than B.S.	20	6
B.S. or equivalent	42	48
M.S. or equivalent	27	34
Ph.D. or equivalent	12	11
Income		
Less than $12,500	22	11
$12,500 to $19,999	55	58
$20,000 or more	23	31
Occupations		
Engineer	39	36
Manager	33	44
Scientist	10	6
Other	18	14

The most dramatic differences between the two requester groups involved the sources they used to learn about the availability of specific TSP's. Whereas Clearinghouse requesters tended strongly to use Tech Briefs as sources, NASA center requesters more often used technical or professional journals (Table 7).

TABLE 7. SOURCES USED TO LEARN ABOUT SPECIFIC TSP's (IN PERCENT)

Sources of Awareness	TSP Distribution Method: NASA Centers (N = 968)	TSP Distribution Method: Clearinghouse (N = 199)
Trade or professional publications	40	14
Tech Briefs	30	66
Other (e.g., colleagues)	30	20

Both requester groups were most interested in TSP's in three technical subject areas: Materials (Chemistry), Electrical (Electronic), and Mechanical. However, the interest shown in these three areas differed considerably between the two groups (see Table 8). The primary reason for the predominant interest of Clearinghouse requesters in Materials (Chemistry) TSP's is that they tended to work in industrial firms closely related to materials handling (e.g., Chemicals, Textile Mill Products). By contrast, NASA center requesters tended to be more evenly distributed throughout the various industrial categories.

TABLE 8. TECHNICAL SUBJECT AREAS (IN PERCENT)

TSP Subject Areas	TSP Distribution Method: NASA Centers (N = 1,094)	TSP Distribution Method: Clearinghouse (N = 237)
Materials (Chemistry)	39	55
Electrical (Electronic)	28	15
Mechanical	21	18
Physical Sciences	5	11
Life Sciences	5	0
Computer Programs	2	1

Only one other area of major difference between the two groups was identified: the professional benefits associated with TSP uses (see Table 9). Proportionately more of the NASA center requesters claimed the TSP's helped them keep up to date with new developments in their fields of interest.

TABLE 9. PROFESSIONAL BENEFITS ASSOCIATED WITH TSP USE (IN PERCENT)

Professional Benefits Identified	TSP Distribution Method	
	NASA Centers (N = 1,094)	Clearinghouse (N = 237)
Current awareness	53	43
Stimulation of research	7	6
Other	6	9
No answer	34	42

Areas of substantial similarity. As shown in Table 10, the two groups differed very little in terms of the technical and financial benefits they associated with TSP uses.

TABLE 10. TECHNICAL AND FINANCIAL BENEFITS ASSOCIATED WITH TSP USE (IN PERCENT)

Technical and Financial Benefits	TSP Distribution Method	
	NASA Centers (N = 1,094)	Clearinghouse (N = 237)
Technical		
Process improvements	14	8
New processes	3	3
Product improvements	3	9
New products	2	3
No answer	78	77
Financial		
Cost savings	3	0
Time savings	6	5
Sales increases	1	0
No answer	90	95

Very few requesters in either of the two groups indicated having experienced any difficulties in trying to use TSP's in their work (Table 11).

TABLE 11. DIFFICULTIES ASSOCIATED WITH TSP USAGE (IN PERCENT)

TSP Usage Difficulties	TSP Distribution Methods	
	NASA Centers (N = 1,094)	Clearinghouse (N = 237)
Insufficient information	6	3
Underdeveloped technology	4	2
Delay obtaining TSP	3	3
Excessive adaptation costs	2	1
Patent-waiver problems	1	0
No difficulties	84	91

One of the most important areas of agreement between the two groups concerned the ratings given to TSP's. Data in Table 12 indicate there was a slight, but not statistically significant, tendency for NASA center requesters to give TSP's higher overall ratings.

TABLE 12. OVERALL TSP RATINGS (IN PERCENT)

TSP Ratings	TSP Distribution Method	
	NASA Centers (N = 853)	Clearinghouse (N = 163)
High	36	31
Medium	32	33
Low	32	36

Conclusion

Since the variety of benefits associated with TSP uses were proportionately the same for each TSP distribution method, the Clearinghouse method effectively reduced the absolute impact of the Tech Brief Program.

SECTION III. TECHNOLOGY TRANSFER EXAMPLE FILES

A major PATT objective in 1970 is to develop a comprehensive set of files documenting examples of space technology transfer. All documented transfer examples, regardless of NASA source, are to be included in the filing system.

The technology transfer example filing system contains three specific elements: (1) a history of each item of technology; (2) a retrieval and analysis mechanism; and (3) a reporting capability.

File Contents

Each file contains a history of the origin of the technology, NASA contributions to the particular technology, dissemination methods used, and specific applications of the technology. To gather the type of information noted, it is necessary to contact Technology Utilization Officers, innovators, and users of the technology.

Each file will contain a historical summary indicating the NASA origin of the technology involved, technical details of the technology, and all documented applications outside of the space program. File summary statements, which will usually be one page or less in length, will be suitable for modification and use in congressional testimony.

At the present time, there are 300 technology transfer example files. Only 13 have been completed to the point that they contain the elements just listed. It is the intent of PATT to have completed at least 150 files by the end of 1970.

Retrieval and Analysis System

Each discrete transfer example in the files will be represented by an IBM card. A sample of the card and a more detailed explanation of information to be coded and keypunched is contained in Appendix B, Exhibits I and II.

The retrieval and analysis system will be operational by July 1, 1970. It will enable PATT to quickly identify all known transfers by several categories: industry, type of technology, size of firm, location, and application area (e.g., recreation, home economics, public health, safety, environment). See Appendix B, Exhibit III, for a complete list.

Reporting System.

A control sheet containing key information on each file will be maintained. The status of the files will be reported in subsequent PATT quarterly reports using the control sheet format (see Appendix B, Exhibit IV, for a one page sample of the control sheet).

New files will be created as new transfer examples are identified through the PATT follow-up system.

In addition, PATT will maintain an up-to-date list of companies using NASA technology in new products. This transferee list will be kept current both at PATT and at TUD. While this list will not be published in future quarterly reports, it may be obtained at any time by contacting either PATT or TUD.

APPENDIX A
Reports of Technology Transfer

REPORTS OF TECHNOLOGY TRANSFER

	Application Actually Resulted	Applications May Result
NEW PRODUCTS	00234521--polymer permeation analyzer 00335443--rescue light 00335907--contamination control 00335909--cardiac telemetry	90829730--trigger generator 00335906--pilot warning indicator
IMPROVED PRODUCTS	90627634--nondestructive testing 90627878--laminar flow benches 90728830--thermal control coatings 00131278--materials soldering compatibility 00131368--contamination control	90526412--automatic inspection of printed circuits 90829482--voltage controlled oscillator 91230895--cryogenic adhesive 00231536--spiking suppression 00331988--high temperature polymers
NEW PROCESSES	90728810--corrosion protection 90829407--halogen corrosion protection 00130128--optical alignment 00130208--optical alignment 00131366--leakage detector 00335441--highway pavement grooving	00231460--nondestructive weld test
IMPROVED PROCESSES	90626764--contamination control 90627552--materials strength test 90729174--contamination control 90729226--contamination control 90729250--contamination control 90829518--removal of damaged surface layers 91230820--chi square test 00230612--contamination control 00131324--contamination control	00131286--contamination control
OTHERS	90728488--relay testing 90829742--contamination control 90829752--energy transfer research 00230520--thermal control paint 91231020--frequency synthesizer 91231078--contamination control 00335912--car of the future	

Case Number: 00234521

A small West Coast firm has been licensed by the Stanford Research Institute (SRI) to manufacture and sell an instrument which is expected to have wide application among manufacturers of polymer films, users of film, and research workers in the polymer field. The instrument, designed for the precise determination of diffusion and permeation coefficients of polymers, was developed by SRI with partial NASA support for more effective and efficient measurement of materials being studied under a contract with the Jet Propulsion Laboratory. Although the commercial version of the instrument is not fully into production, the first units have been sold and scheduled for delivery.

Subject	Technology Source
Dohrmann Instruments Company 1062 Linda Vista Mountain View, California 94040 415-968-9710 Contact: James A. McNulty Manager, Analytical Instruments Division	Dohrmann Instruments and Stanford Research Institute

Dohrmann Instruments, a subsidiary of Infotronics Corporation, is a small company that manufacturers and markets a variety of analytical instrumentation, controls, and recorders. Based on a license agreement with SRI, the company has recently added to its product line an instrument initially developed by SRI for precise dynamic determination of diffusion and permeation coefficients of polymer materials. The initial instrument, developed by SRI with partial NASA support, was the outgrowth of a contract with the Jet Propulsion Laboratory to study and test potential bladder materials for propulsion system application.

After being selected to manufacture and sell the instrument, engineers at Dohrmann Instruments took the basic SRI technology and developed an instrument with increased capability that could be applied to industrial use. The first model has been exhibited in New York and Cleveland, an advertising program and a program for distribution on a national basis have been established, and the first units have been sold and scheduled for delivery. The instrument is expected to receive wide application among manufacturers and users of polymer materials to assure that materials meet specification requirements and among research workers in the polymer field to test and verify experiments.

Case Number: 00234521 (Cont.)

The initial model, selling for $6,500, will be a complete unit ready for application by the user. Other models with different accessories will also be available. One such model will be designed for use in testing frozen food packaging under sub-ambient conditions. James A. McNulty, manager of the Analytical Instruments Division, said that initially the instrument is expected to represent less than 10 percent of the company's total sales volume; however, within two or three years, it could become a major product line for the company.

RLB:ss
4/1/70

Case Number: 00335443

An East Coast electronics manufacturer is marketing a special rescue light originally developed for NASA, the Air Force, and the Navy. The portable rescue device, a high-intensity flashing light, is being sold to private and commercial aircraft personnel; commercial and sports fishermen; tanker, freighter, and ocean liner crews and passengers; mountain climbers; skin divers; explorers; hunters; hikers; skiers; spelunkers; police; and firemen. Because of the high intensity of the light, it can be seen from a distance of 10 to 20 nautical miles, depending upon visibility and altitude. Flashes can also be seen under water and through waves and fog.

Subject

ACR Electronics Corporation
160 5th Avenue
New York, N. Y. 10010
Contact: Nick Reigley
Public Relations Manager
(part-time for ACR Electronics
and full-time for Cromarine)

The ACR Electronics Corporation has developed a special rescue device, the ACR-4F Rescue Lite, for NASA, the Air Force, and the Navy. According to an article in Safety Journal (April 1969), the ACR lights were aboard both the Mercury and Gemini spacecraft and have been credited with saving 45 military pilots during 1968. The new rescue light is now being sold to many groups, including police, firemen, and various rescue operation teams.

The device is a high-intensity flashing light, smaller than a package of cigarettes and weighing only 8 oz., including batteries. It is completely waterproof and will operate submerged to a depth of 200 feet. The ACR-4F produces a brilliant flash of light that is the same color temperature as sunlight, and is visible at a distance of from 10 to 20 nautical miles, depending upon visibility conditions and altitude. Flashers can be seen underwater and through waves and fog.

Developing 100,000 peak lumens of light per flash, the miniature rescue light flashes 50 times per minute. Under continuous use, the ACR-4F has a nine-hour life cycle. Shell life of the mercury-type batteries, which are replaceable, is five years. They can be changed under water, if necessary.

Case Number: 00335443 (Cont.)

The device is completely encapsulated in heavy plastic casing, with a transparent protective shield fitted over the lighting element. It operates in temperatures from 32 to 140 degrees although batteries for extreme cold can be supplied. Since the unit is extremely lightweight and costs $29.95, it would be a practical addition to a rescue kit. Approximately 500,000 ACR-4F Rescue Lites have been sold in the government and civilian sectors thus far.

GHP:kcr
3/16/70

Case Number: 00335907

An Engineer who was developing spacecraft dust covers has applied NASA contamination control technology to human health needs. After consulting a professor of surgery and a medical researcher, he developed a now-patented air filtration system which today is in widespread use in the medical and pharmaceutical fields. The system is used to keep cancer, disease, burn, and transplant patients alive during the time when their immunological defense mechanisms are critically depressed. Sales of the system in the past twelve months exceeded $400,000, and sales of one-half million dollars are predicted for the coming year.

Subject

Contamination Reduction System (CRS)
1050 Colwell Lane
Conshohocken, Pennsylvania 19428
215-825-3155
Contact: James Horneff
Engineer

Engineer James Horneff of Contamination Reduction Systems (CRS) began considering prototype air filtration systems for possible medical use while working on a subcontract to provide the NASA spacecraft assembly operation with dust covers. Utilizing a high efficiency particulate air filter, developed originally by Sandia Corporation, Horneff designed an air filtration and distribution system which has since found important and diversified applications in biomedical research, pharmacology, and day-to-day hospital problems.

An article in the Journal of the American Medical Association reported one application of the CRS filtration system: ". . . Using a combination of high efficiency particulate air filters (HEPA) and a plenum type of vertical air flow, it was possible to essentially eliminate airborne bacteria from ambient air throughout the operating room within minutes after starting the air filtration system. Microbiological monitoring of 14 operations in the clean room showed that viable particulates in the operating field were reduced 10 to 18 fold within 2 to 3 minutes of turning on the filter . . . ." The article stated that the system is 99.97 percent effective in removing, from a surgical room containing 6 to 10 persons, particles as small in diameter as 0.3 micron (0.0000118 inches). This

Case Number: 00335907 (Cont.)

aerobic microbiological contamination count indicates that staphylococcal and psendomonas airborne particles, principal sources of surgical room infections, are being effectively eliminated from the surgical atmosphere.

Dr. Raphael Levy of the Boston Children's Hospital stated that one boy who would otherwise have probably lived only two weeks was kept alive for eight months by being housed in the system. Other applications of the system have been to house patients recovering from transplant surgery, those receiving massive doses of radiological or chemotheraphy (particularly cancer victims whose white corpuscle weight has been driven from a normal count of 100,000 - 150,000 down to 1,000), and other patients with depressed immunological defense mechanisms. The system is used routinely for burn victims, for post major-surgical recovery, and for the controlled isolation of patients with highly infectious diseases.

In laboratory applications the system is used to safely transfer tissue cultures from one container to another without risk of airborne infection. Laboratory animals receiving conventional infection controls usually have 40 to 85 percent morbidity/mortality rates; housed in the CRS system these rates drop to one-half of one percent, as determined in over one hundred animal experiments at the M. D. Anderson Hospital, Houston, Texas.

Additional applications under study include isolation of newborn infants, and of asthmatic and emphysema victims. Another possibility is filtering contaminated hospital air, which air conditioning systems ordinarily transfer from emergency waiting rooms (often occupied by persons carrying highly infectious diseases) throughout a hospital.

CRS has in the past year sold several dozen small filtration systems ($2,000 each), one dozen large units ($20,000 each), and one very large unit ($120,000). Sales for the coming twelve months are anticipated at about one-half million dollars.

JK:jd
3/31/70

Case Number: 00335909

Expertise acquired by the bioengineering group of a large Northeast aerospace contractor in developing the Apollo astronaut's life support lunar backpack is now being translated into life-saving devices in increasing use by physicians, hospitals, and nursing homes. Sales of one such device already exceed $60,000, and sales of another are in excess of $400,000.

Subject

Hamilton Standard
Division of United Aircraft
Windsor Locks, Connecticut
203-623-8888
Contact: Ronald Lang, Manager
Bio-medical Systems
Department

Introduced to medical electronics through a 1960 R & D contract with NASA to develop a telemetry-type cardiac monitoring system for astronauts, Hamilton Standard has translated and extended that expertise to a number of monitoring, ameliorating, and life-saving devices. The battery powered EKG cardiac transmitter developed for NASA has been adapted commercially as a wireless transmitter for intensive care post-coronary patients. Over 400 of these wireless channels are now in the field, selling for $1,000 to $1,500 each.

Monitoring such patients has characteristically been a tedious and often perilous procedure, since a cardiologist must be on hand at the time an emergency occurs. With an innovative addition to their transmitter, Hamilton Standard now enables such a patient to transmit his EKG directly to the cardiologist wherever he might be, via telephone relay from the patient to an oscilloscope, real-time printout, or computer accessible to the specialist for undistorted, clinical quality data.

With this advance warning the cardiologist can take the necessary precautionary actions and often save the patient's life. Although this innovation was only introduced in November 1968, several hundred have already been sold at a cost of $660 each.

Case Number: 00335909 (Cont.)

Another device, just being introduced, which can trace its origins to work done by Hamilton Standard on the Lunar Excursion Modules' environmental control system, is called an Intermittent Positive Pressure Breathing Apparatus (IPPB). It is a form of respirator for assisting emphysemics and other pulmonary patients, employing fluidic circuitry for controlled intermittent breathing assistance functionally dependent upon the patient's immediate and varying needs for changes in flow, mix, and temperature of gases.

Standard has also developed, primarily with company funds, a computer controlled heart pump called Simas. A heart attack patient is put on the pump, which takes over much of the heart's work. The Simas pump is attached by tapping the patient's arterial system, usually in an arm or leg. Just prior to the heart's pulse, the pump withdraws a controlled amount of blood, allowing the weakened heart to pump against a diminished impedance, or resistance. Just before the heart relaxes, the pump returns the newly oxygenated blood under pressure, which drives or assists the arterial system by forcing the blood through collateral, long unused arteries, gradually opening them up again for normal use. These collapsed, or infarcted, areas are thus gradually forced back to healthy usefulness, despite the weak heart muscle. The procedure is called "counterpulsation."

The manager of the Bio-medical Systems Group regularly delivers speeches to medical groups, citing Standard's space-derived expertise as the basis for these devices. He is, he says, "a confirmed believer" in the efficacy of technology transfer.

JK:kcr
3/19/70

Case Number: 90627634

A Midwestern tool company has incorporated nondestructive testing in its inspection process which has resulted in improved product quality and reduced manufacturing costs. Recognizing its customer's needs for more quality in cutting tools, company engineers determined what their equipment needs were after studying NASA information developed for Marshall Space Flight Center on the fundamentals of nondestructive testing of finished components using magnetic particles. In addition to providing the intangible benefit of improved product quality, manufacturing costs have also been reduced since defective parts are now stopped early in the production process.

Subject	Technology Source
A Midwest Tool Company Contact: Chief Metallurgist	Marshall Space Flight Center Tech Brief: 68-10391, "Training Manuals for Nondestructive Testing Using Magnetic Particles"

Recognizing the importance of continually improving product quality, the chief metallurgist at a Midwest tool company requested information from NASA on nondestructive testing as suggested in an article he had noticed in a trade publication. The company had not been using nondestructive testing in its inspection process and it was felt that the use of the method might not only contribute to improved product quality but that it might also reduce manufacturing costs.

The NASA handbook on nondestructive testing using magnetic particles was used by company engineers to determine what their equipment needs were and to justify the need for capital expenditures on the equipment. As a result of incorporating nondestructive testing in its inspection process, the company spokesman said definite improvements in product quality have been experienced. He also indicated that manufacturing costs have been reduced since defective parts are now detected earlier in the production process. Although the spokesman could not estimate the specific savings, he did say they were "substantial."

RLB:kh
2/18/70

Case Number: 90627878

A small Midwestern manufacturer of clean room equipment is using the Marshall Space Flight Center "Contamination Control Handbook" as a design aid and reference book for customer inquiries. He estimates that his use of the handbook contributed importantly to improving the design of his laminar flow benches which have anticipated sales in the coming year of $50,000.

Subject	Technology Source
Dexon, Incorporated 3440 Belt Line Boulevard Minneapolis, Minnesota 55416 612-927-5671 Contact: Max D. Peters Operations Manager	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

The "Contamination Control Handbook" is considered "extremely valuable" by Max Peters, Operations Manager of this small clean room equipment manufacturer. He reported that it is unsurpassed as an authoritative sales aid when in consultation with customers, who immediately recognize its authority and recommendations thereby improving the sales environment.

Using the handbook as a design aid, Peters developed a laminar flow bench with an automatic sensor to control flow differentials about, and efflux velocity from the blower filter, and so guarantee specified filtration velocities. On the market less than a month, sales of this bench are already $1,000 with $50,000 anticipated during the next twelve months.

JK:bh
1/26/70

Case Number: 90728830

The availability of NASA-generated technology on thermal-control coatings aided engineers at a large New England electronics company in making product improvement changes on capacitors and reduced the company's research and development costs by approximately one man-month of effort. The technology identified specifications for the formulation and application of thermal-control coatings which the company used in conjunction with its research on capacitor heat and vibration problems. Although the technology did not provide a solution to the vibration problems, it did help the company solve certain capacitor hot spot problems.

Subject	Technology Source
Sprague Electric Company Research Center Marshall Street North Adams, Massachusetts 01247 413-664-4411 Contact: D. R. Ruthman Design Engineer	Jet Propulsion Laboratory Tech Brief: 68-10553, "Structural Thermal Control Coating"

Engineers at the Sprague Electric Research Center are concerned with heat and vibration problems associated with the design and packaging of capacitors. Sprague Design Engineer D. R. Ruthman said he anticipated that specifications on thermal-control coatings he discovered in a NASA TSP would provide a satisfactory solution since the problems required the use of a confining material that reduces capacitor hot spots and vibration.

Although the NASA technology did not provide a satisfactory solution to the vibration problems, it did help the company solve certain capacitor hot spot problems which will increase the life of the capacitors. The technology received from NASA also was used by the company's engineers in establishing the scope of work. Ruthman said he could not estimate the monetary savings resulting from the improved capacitor design, but he did estimate that the availability of the NASA-generated technology reduced research and development effort by one man-month

Case Number: 90728830 (Cont.)

since it guided engineers in some of their thinking and prevented them from going off on a tangent. Ruthman said he was quite satisfied with the TSP; he described it as "a well written document."

RLB:sjs
1/30/70

Case Number: 00131278

NASA technology on the compatibility of printed circuit and component lead materials enabled a New England division of a major electronics company to overcome problems with cracking soldered joints which resulted in improving product reliability, reducing rejection rates, and increasing product life. The division had been experiencing problems with cracking where gold plated components required soldering to printed circuits. However, through the application of revised soldering techniques suggested by the Marshall Space Flight Center document, a satisfactory solution to the problem has been developed.

Subject	Technology Source
Raytheon Company Missile System Andover, Massachusetts 01810 617-475-5000 Contact: K. D. Stevenson Quality Control Engineer	Marshall Space Flight Center Tech Brief: 68-10310, "Standards for Compatibility of Printed Circuit and Component Lead Materials"

At the Missile System Division of Raytheon, problems were being experienced in manufacturing memory circuits (flat packs) to be used in one of the systems manufactured by the company. The system requires the use of gold plated components which must be soldered to printed circuit boards to make up the memory circuits. Because of difficulties with the compatibility of the materials required, cracks were being detected in the solder joints resulting a high rejection rate. To overcome this problem, the division's quality control engineers referred to NASA technology and other available sources on the compatibility of materials and soldering which provided an overall solution to the problem.

Although the NASA information was not the only source consulted, Quality Control Engineer K. D. Stevenson said that the basic technique of tinning the component leads before soldering was taken directly from the NASA document. By incorporating this technique, Mr. Stevenson said he was able to reduce the cracking problem. This resulted in improved product reliability reduced rejection rate, and increased product life. The NASA information has also been used by the division

Case Number: 00131278 (Cont.)

for visual inspection of soldered joints through comparison of NASA pictures on soldered joints to the results being experienced by the division.

Mr. Stevenson does not normally see NASA Tech Briefs. He said he learned about the availability of the NASA document through an article in a quality assurance magazine. Mr. Stevenson commented that the NASA document was "very good," and he particularly liked the way the information was "approached statistically."

RLB:ad
3/20/70

Case Number: 00131368

A New York State dry cleaning equipment manufacturer has used contamination control technology, prepared for the Marshall Space Flight Center, to make equipment and processing modifications. The marketing manager of the firm estimated that $150,000 worth of business resulted during the past year by using this information. While he said future sales are not accurately predictable, he said they are likely to be at a higher level.

Subject	Technology Source
American Permac, Incorporated One Commercial Avenue Garden City, New York 11530 516-747-7700 Contact: H. Edward Beekman, Jr. Marketing Manager	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

American Permac, Inc. manufactures dry cleaning equipment for a wide variety of customers. In recent years, some of their customers have used the equipment to dry clean garments worn in clean rooms, hospitals, etc. The NASA document was requested by Marketing Manager Edward Beekman to acquaint both himself and the technical staff with the latest contamination control techniques.

The information and techniques contained in TSP 68-10392 "Contamination Control Handbook" have been used by American Permac, Inc. to modify dry cleaning equipment and systems for customers.
Mr. Beekman estimated that additional sales of $150,000 were generated during the past year as a result of these modifications. These sales were for special applications in hospitals and dry cleaning places supporting clean room operations. According to Beekman, the future sales level will probably be greater than that realized to date. He foresees a significant application for special equipment to remove bacteria as well as particle contamination in places like hospitals, drug manufacturing plants, etc. The handbook provided a good knowledge of contamination techniques that was needed to modify equipment and processes to meet the special requirements of customers.

GFF:kcr
3/25/70

Case Number: 90728810

E. I. duPont de Nemours is now producing less costly, longer lived, more reliable automatic control instrumentation by using corrosion protection techniques described in a Marshall Space Flight Center TSP. Annual savings to the duPont company, in fabrication costs, and to their customers, in factory servicing costs, are estimated at $10,000.

Subject	Technology Source
Spruance Film Research and Development Lab. E. I. duPont de Nemours and Company P.O. Box 1559 Richmond, Virginia 23212 703-275-8311 Contact: E. B. Burns Research Engineer	Marshall Space Flight Center Tech Brief: 69-10098, "Corrosion Protection of Aluminum Alloys in Contact with other Metals"

The Automatic Process Control Instrumentation group at duPont was experiencing unacceptably high failure rates in immersible control instrumentation used in processing cellophane and polyacetate film. E. B. Burns, a research engineer in the group, used Marshall Space Flight Center corrosion protection techniques to modify the instrumentation cases. According to Burns, the new technique has practically eliminated chemical corrosion and electrolytic coupling problems.

By switching from expensive and relatively ineffective stainless steel instrumentation cases to anodized aluminum, he eliminated corrosion failure and reduced production costs by $50 per instrument. Burns estimated annual savings to duPont and their customers of at least $10,000, directly attributable to this application of space technology. He stated that fabrication costs during the past year were reduced by at least 50 percent, and that at least 100 additional man-hours should be saved next year.

Describing this particular use of the corrosion protection technology as "quite significant," Burns said he regards the spin-off from space technology as "important and useful."

JK:bh
3/6/70

Case Number: 90829407

Halogens are among the most chemically reactive elements known; containerizing, storing and transporting them present difficult problems, such as explosiveness and extreme reactivity with light metals. The chemicals laboratory of a major Eastern chemical manufacturer has successfully utilized information in a Marshall Space Flight Center TSP to more efficiently handle these difficult materials.

Subject	Technology Source
The Dow Chemical Company Chemicals Laboratory 1710 Building Midland, Michigan 48640 Contact: Dr. R. S. Karpiuk Administrative Manager	Marshall Space Flight Center Tech Brief: 69-10098, "Corrosion Protection of Aluminum Alloys in Contact with other Metals"

Rust inhibitors used in automotive radiators are precisely analogous to the inhibiting agents used by chemical manufacturers in those elements or compounds whose reactivity or instability create otherwise difficult or dangerous storage and transportation problems. Such additions must themselves be carefully researched to guarantee minimum interference with the properties of its host, and are therefore an added cost and nuisance factor.

Seeking a more efficient method for handling such halogenated organic compounds as carbon tetrachloride, chloroform and other chlorinated solvents, scientists at Dow Chemical's Midland, Michigan laboratory turned to a NASA Tech Brief describing corrosion protection of aluminum alloys. The anodizing process described in this paper was used to protect the aluminum slipping containers from attack by the chlorinated solvents.

Dr. R. S. Karpiuk, Administrative Manager of the chemicals laboratory, estimated at least 50 hours of research time have been saved which otherwise would have been applied toward seeking a solution to this problem.

Describing NASA's Technology Utilization Program as "a very important source of expertise," Dr. Karpiuk stated he regularly delivers lectures on the advantage of this enormous body of available knowledge. He said he deplores the lack of "awareness" of these often untapped resources

Case Number: 90829407 (Cont.)

and emphasized strongly their usefulness to researchers both in time savings and avoiding duplication of effort. He indicated he regularly received Tech Briefs, and subscribes to the services of a Regional Dissemination Center.

JK:ad
3/13/70

Case Number: 00130128

An Air Force research facility has made use of technology developed by the Marshall Space Flight Center to improve alignment techniques used to accurately position the optics required for research tests. At least 200 hours of test personnel time have been saved, and this revised procedure is now routinely performed by the engineers and technicians.

Subject	Technology Source
Arnold Research Organization (ARO), Incorporated Arnold Air Force Station Tennessee 37389 615-455-2611 Contact: J. R. Lernert Manager, Engineering Research Technical Staff	Marshall Space Flight Center Tech Brief: 68-10574, "Training Manual on Optical Alignment Instruments"

The Arnold Research Organization (ARO), Inc., operates the Arnold Air Force Station under contract to the USAF. During the conduct of research on measurements using doppler shift techniques, ARO engineers encountered problems with the alignment of optical test equipment. They requested the TSP to help resolve the test difficulties.

Engineering Manager J. R. Lernert indicated that the NASA document, "Optical Alignment (Basic)," helped ARO engineers to align more accurately all optical elements used in wind tunnel tests. According to Lernert, the once critical alignment techniques are now considered routine. Lernert indicated that the techniques described in the TSP also had been incorporated into a number of other associated research efforts where alignment of elements was critical.

Lernert stated that at least 200 hours had already been saved in optics alignment efforts. While he was unable to estimate the magnitude of future savings, he predicted they would be significant. He also said that ARO regularly received Tech Briefs, and that NASA technology has been helpful to R & D efforts.

GFF:ad
3/24/70

Case Number: 00130208

An Ohio manufacturer, using a NASA optical alignment training manual, has developed a new technique for producing atomic reactor fueling equipment. A company spokesman estimates the firm has saved at least 100 development man-hours by using the manual. He predicts additional savings will be realized when the new equipment is manufactured.

Subject	Technology Source
Diamond Power Specialty Corporation P.O. Box 415 Lancaster, Ohio 43130 Contact: John C. Singleton Engineer	Marshall Space Flight Center Tech Brief: 68-10574, "Training Manual on Optical Alignment Instruments"

Diamond Power Specialty Corporation manufactures soot blowers for various companies in the power boiler industry. The Corporation is currently attempting to enter the nuclear fuel handling equipment field. A need for new technology to support this effort prompted the request for the NASA document.

The equipment being developed requires highly accurate three-axis positioning. Diamond engineer John Singleton said conventional fabrication and inspection methods are not accurate enough because of the large size of the crane system equipped to perform the fuel handling. He said that the training manual on optical alignment methods, prepared by the Marshall Space Flight Center, was used to establish the new techniques needed to manufacture the equipment. Proposals to produce the large complex machinery have been prepared and, according to Singleton, a contract soon may be signed. He said he was very pleased with the NASA Training Manual. He estimated it had saved his firm at least 100 hours (at $11.00 per hour). He would not estimate future savings in production time, but said that they would be significant.

GFF:ad
3/24/70

Case Number: 00131366

A NASA-developed method for determining the rate of gas leakage has proven quite useful to an East Coast manufacturer of life support equipment. The manufacturer is using the technology to estimate the amount of oxygen leakage from survival kit oxygen systems. Since the oxygen system design allows for a certain amount of leakage, the NASA estimating method is quite acceptable and has proven an economical method for testing the oxygen system during the assembly operations.

Subject	Technology Source
Automatic Sprinkler Corporation Scott Aviation Division 225 Erie Street Lancaster, New York 14086 716-683-5100 Contact: John L. Sullivan Manager, Engineering	Marshall Space Flight Center Tech Brief: 68-10393, "Determining Gas Leakage from Bubble Formations"

Scott Aviation of Lancaster, New York, produces survival kits. In designing the oxygen systems, company engineers recognized that a certain amount of oxygen leakage will be experienced because of the permeability of "O" rings used in the systems. Although it is necessary to estimate the amount of oxygen leakage, Engineering Manager J. L. Sullivan said that the use of sophisticated leak detection methods is not economically feasible. Therefore, use of the simplified and practical method developed by NASA for determining the rate of leakage has proven to be quite satisfactory to the company.

Although the NASA method does not locate gas leaks, it does provide an economical method for estimating the total amount of leakage. It has proven to be a practical method for testing the system during assembly operations. This, in turn, has facilitated equipment buy-off and has reduced the amount of rework time required. Sullivan could not estimate the monetary and time savings resulting from his use of the NASA method but he indicated that definite savings have resulted.

Case Number: 00131366 (Cont.)

Sullivan commented that the Technical Support Package received from NASA was well presented and that it is quite useful in training new people.

RLB:jd
3/24/70

Case Number: 00335441

During the summer of 1969, the Pennsylvania State Department of Highways began using a NASA-developed technique for reducing skidding and hydro-planing. The technique, pavement grooving, has resulted in a "substantial reduction in automobile accidents" on dangerous road stretches. Although pavement grooving was originally applied to airport runways, the method is presently used on highways in California, New York, Texas, Pennsylvania, and Connecticut. The difference in application primarily involves the use of longitudinal grooving for highways (parallel to the flow of traffic) rather thanlatitudinal grooving for runways (perpendicular to the direction of aircraft movement).

Subject

Pennsylvania State Highway Department
Materials, Testing and Research Bureau
Harrisburg, Pennsylvania
717-787-5593
Contact: Wade Gramling
Research Engineer

News stories in Northampton County Motorist (September 1969), Constructioneer (September 22, 1969), and the Keystone Motorist (September 1969) briefly described Pennsylvania's use of grooving for highways. Favorable results from use on California highways and various airport runways throughout the nation prompted the Pennsylvania officials to explore the process further. After talking with NASA officials and reviewing the technology on grooving, the Pennsylvania State Department of Highways grooved 4 highway sections in eastern and northeastern Pennsylvania.

The program has been in effect for approximately eight months. Since their data are gathered on an annual basis, no specific accident frequency data were available. However, the Pennsylvania official indicated that a "substantial reduction in accidents had already occurred."

The highway department engineer also stated that hydro-planing did not seem to be a serious problem in highway accidents. He felt that this phenomenon generally occurred on very wet pavements at speeds in excess of 70 miles per hour, depending upon the condition of the road, tires, weight of car, etc. Since cars traveling in the grooved areas

Case Number: 00335441 (Cont.)

rarely encounter these conditions, the engineers concluded that the grooves prevented side slip (since the grooves run longitudinally). Thus, the vehicles were less likely to be involved in uncontrollable spin-outs.

Experimental data indicate that the durability of the road surface was high, grooving costs were not a substantial part of road construction costs, no unusual problems were encountered, and, most importantly, accident frequency was reduced. Consequently, highway officials plan to employ the grooving technique in the future.

GHP:ad
3/5/70

Case Number: 90626764

A New York hydraulic mechanisms manufacturer used information in the NASA "Contamination Control Handbook" to improve parts cleaning procedures employed during the production of precise mechanical components. A quality assurance supervisor estimated that the use of this NASA technology will save his firm $20,000 per year because of reduced material and labor costs during component manufacturing operations.

Subject	Technology Source
Aerospace Division Moog Incorporated Proner Airport East Aurora, New York 14052 716-652-2000 Contact: Thomas S. Sokolowski Quality Assurance Supervisor	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

The Aerospace Division of Moog, Inc. produces hydraulic mechanisms for a wide variety of aircraft and missile applications. Close fitting parts are needed in such applications; for example, precise tolerances as low as 40 millionths of an inch often are required. In this type of manufacturing operation, particle contamination can cause serious problems.

Quality Assurance Supervisor Thomas S. Sokolowski ordered the "Contamination Control Handbook" to obtain the latest information available dealing with clean room operations. He said he has used information in the document to prepare revised procedures for cleaning mechanical parts with Freon TF. Used between production steps, these techniques have reduced the level of particle contamination on components being manufactured. Subsequent operations are more accurately performed because of the cleaner parts.

Sokolowski said his use of the NASA handbook helped him save several hours during the preparation of revised contamination control procedures. He estimated continuing savings totaling approximately $20,000 per year in reduced labor and material costs.

GFF:sjs
3/30/70

Case Number: 90627552

Metallurgists at a major New England aircraft engine manufacturing company have applied a simplified NASA method for measuring changes in yield strength using a least number of specimens technique. The method, developed for the Space Nuclear Propulsion Office, has been used in testing the effects of diffusion coatings on various alloys and in checking the response of alloys to heat treatment. In addition to providing a satisfactory testing method requiring fewer specimens, the NASA information stimulated basic and applied research in other company activities where satisfactory test results can be obtained with fewer specimens. Although the NASA method is used on a limited basis, it probably will see wider application after it has been adequately demonstrated and verified.

Subject	Technology Source
Pratt and Whitney Aircraft Company 400 Main Street East Hartford, Connecticut 06108 203-565-4321 Contact: J. F. Holloway Project Metallurgist	Space Nuclear Propulsion Office Tech Brief: 67-10266, "Simplified Method Measures Changes in Tensile Yield Strength Using Least Number of Specimens"

At the Pratt and Whitney Aircraft Materials Laboratory numerous tests are performed on many different materials. Because the tests involve the use of expensive alloys, company metallurgist Mr. J. F. Holloway said he was interested in developing simpler and more economical testing techniques.

Through an article in a professional journal, Mr. Holloway learned of a simplified "least number of specimens" testing method developed for NASA which he used to test the tensile strength of different alloys. He used the NASA method to check alloy tensile strengths and the response of alloys to heat treatments. Although minor modifications were made in the testing method, basically the NASA information was used as presented in the Technical Support Package.

In addition to providing the Materials Laboratory with a satisfactory testing method, the NASA information stimulated interest in other areas of the company where satisfactory test results could be obtained

Case Number: 90627552 (Cont.)

with fewer specimens. However, before the "Least Number of Specimens" method is widely used, it must be further refined. Mr. Holloway indicated that the NASA information has been forwarded to the Pratt and Whitney Quality Assurance Department for consideration as an economical technique suitable for testing receiving area materials.

RLB:kw
3/24/70

Case Number: 90729174

A California electronics manufacturing company used NASA's "Contamination Control Handbook" in modifying a machine in its plant. The change was made to provide a stream of filtered air to dry special films produced by the equipment. Surface contamination on the film was reduced in such a way that 30 percent more of the machine's output could be used for subsequent manufacturing operations. A company engineer estimated that this processing improvement could reduce the firm's production costs by $50,000 per year.

Subject	Technology Source
San Fernando Electric Manufacturing Company 1509 First Street San Fernando, California 91341 213-365-9411 Contact: Charles E. Hodgkins Research Engineer	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

The San Fernando Electric Manufacturing Company produces a line of ceramic capacitors for the electronics industry. Research Engineer Charles E. Hodgkins ordered the NASA "Contamination Control Handbook" to assist in the solution of a contamination problem in the production process for these items.

A machine in the plant produced very thin films composed of ceramic material in plastic. Its wetness attracted surface contamination of lint and dust which caused a high reduction rate. Using information in the handbook, company engineers modified the machine in such a way that film drying was performed with a vertical laminar flow of filtered air. The cleaner environment significantly reduced surface contamination and 30 percent more of the machine's output was useable. Hodgkins said that an unnual savings of $50,000 appeared quite possible. He indicated this estimate included reduced labor hours required for film processing and more efficient utilization of materials.

GFF:sjs
3/31/70

Case Number: 90729226

A West Coast division of a major electronics company has used the NASA "Contamination Control Handbook" to prepare operating procedures for its clean rooms. A company scientist stated that this document is one of the best sources of information on the subject he has been able to find. He estimated his use of the document had already saved $1,000 in labor costs and that such cost reduction benefits would continue in the future.

Subject	Technology Source
Nuclear Energy Division General Electric Company Vallencitos Road Pleasanton, California 94566 415-862-2211 Contact: John L. Yee Chemist, Special Measurements	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

The General Electric Company's Nuclear Energy Division is engaged in designing and manufacturing nuclear reactors. Scientist John Yee requested TSP 68-10392, entitled "Contamination Control Handbook," for information regarding the proper operation of clean rooms. He used this NASA document as a guideline for preparing improved procedures to be used by research personnel working in these facilities. Yee stated that the manual was an excellent source of information on the subject. He estimated that $1,000 in research labor was saved in preparing the revised procedures. Yee said some future cost savings will be realized, but indicated he could not predict their value.

GFF:bh
3/31/70

Case Number: 90729250

Faced with persistent contamination problems in producing digital magnetic head assemblies, a small West Coast manufacturer of computer accessories utilized the "Contamination Control Handbook" developed for Marshall Space Flight Center. Use of the NASA information to design his own clean room and to develop methodological controls enabled the manufacturer to effectively eliminate his contamination problem, thus significantly improving his competitive position.

Subject	Technology Source
Computer Peripherals Corporation 5037 Ruffner Street San Diego, California 92111 714-279-7500 Contact: D. W. Kramer Vice President and Director of Manufacturing	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

D. W. Kramer, Vice President and Director of Manufacturing of the Computer Peripherals Corporation, indicated recently that the NASA "Contamination Control Handbook" has "helped us immeasurably." Because of the unusual sensitivity of digital magnetic head assemblies to particulate contamination, it was necessary for the firm to rapidly acquire a sophisticated state-of-the-art expertise in contamination control technology. The handbook was largely responsible for providing this capability, and in addition, improved in-plant methodology sufficiently to reduce clean room personnel from six to four persons. Of particular interest to Kramer were the comprehensive descriptions of laminar flow tunnels and benches, contributing importantly to the design of the firm's clean room.

JK:bh
1/27/70

Case Number: 90829518

Incorporation of a Marshall Space Flight Center method for removing the damaged surface layer caused by electrical-discharge machining (EDM) has resulted in an initial savings of over $2,500 for the East Coast division of a major electronics corporation. The NASA information enabled company engineers to improve existing processes and satisfactorily remove the brittle layer on turbine blades caused by EDM. As a result of the improved processes, the number of manufacturing operations and tests required to remove the damaged layer has been reduced.

Subject	Technology Source
Westinghouse Electric Corporation Steam Division Box 3175 Philadelphia, Pennsylvania 19113 215-595-2244 Contact: W. J. McCall Metallurgical Engineer	Marshall Space Flight Center Tech Brief: 68-10522, "Method for Removing Surface-Damaged Layers From Nickel Alloys"

At the Steam Division of Westinghouse Electric Corporation, electrical-discharge machining (EDM) is used in the manufacturing of blades for gas turbines. The use of EDM creates a brittle or damaged surface layer which had been removed by grinding at the division. The use of grinding, however, requires a number of manufacturing steps which are interrupted by the necessity of frequent surface checks.

After receiving information from NASA on a better method for removing the damaged layer, Steam Division engineers examined a number of test pieces using the grit blasting method recommended in the TSP. The test results were quite satisfactory and the method has now been incorporated into the manufacturing process. The new method requires fewer tests than did the previous method and has resulted in initial savings of over $2,500. Metallurgical Engineer W. J. McCall said that the possibility of using EDM on other products and materials is being explored. If the use of EDM is expanded, he predicted savings generated from the use of the NASA method will be significantly increased.

RLB:ss
2/9/70

Case Number: 91230820

A division of a plumbing and heating manufacturing company located in the South has incorporated information it received from NASA on the use of the Chi Square (χ^2) Statistical Test which has contributed to improved process controls and reduced operating costs. The NASA information, developed by the Goddard Space Flight Center, will replace the statistical model previously used by division engineers to determine contingencies when process changes are made. The Quality Control Manager reported that the NASA information was crucial to his operation and particularly important in improving foundry practices. He indicated that time and monetary savings resulting from the use of the information were "substantial."

Subject	Technology Source
Division of a Plumbing and Heating Manufacturing Company	Goddard Space Flight Center Tech Brief: 68-10136, "The χ^2 Statistic and Goodness of Fit Test"

A major division of a plumbing and heating equipment manufacturing company uses statistical tests in its process controls. The test,used most often in sand control, enable company engineers to determine contingencies when process changes are made. The manager of Quality Control indicated that the company's foundry processes approximately 650 tons of sand daily. He said he learned about the NASA-developed technology, which he felt at the time might increase sand processing efficiency, while he was reading an article in a professional journal.

The NASA technology involved a modification of the Chi Square (χ^2) Statistical Test used frequently by the company. The company spokesman said the new χ^2 test provided his division with more adequate quality control techniques and he regarded the NASA-developed technique as "crucial" in operating the foundry. Although he was unable to estimate the monetary savings resulting from his use of the NASA information, he stated savings were "substantial." He predicted that continued savings will be realized in the future, since he will continue

Case Number: 91230820 (Cont.)

using the test. Although the company does not receive NASA Tech Briefs, he said a definite interest in the Technology Utilization Program has developed as a result of this experience.

RLB:sjs
3/17/70

Case Number: 00230612

A research and development laboratory of a large Midwestern chemical company has used contamination control technology in designing a variety of special laboratory facilities for the conduct of human cancer research. Part of the information used in this effort came from the "Contamination Control Handbook" prepared for the Marshall Space Flight Center. The facilities designed included a complete research building, different types of portable laboratories, and small special equipment items. The project manager could not estimate the savings resulting from the availability of the NASA technology, but he indicated that his firm had saved a considerable amount of time and effort.

Subject	Technology Source
Human Health Research and Development Laboratory Dow Chemical Company P.O. Box 10 Zionsville, Indiana 46077 Contact: Dr. Joseph McDade Research Project Head	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

Cancer research is currently being performed by the Human Health Research and Development Laboratory of the Dow Company. As part of this program, Dow personnel have designed a variety of special facilities that employ the latest in contamination control techniques. Some of the technology used in this effort came from the "Contamination Control Handbook" which was prepared by the Sandia Corporation for Marshall Space Flight Center. Dow Project Manager Dr. Joseph McDade assisted in part of the writing of this NASA document. He stated that the document is a useful working guide in designing items where contamination control is required.

The facilities developed for Dow cancer research include a complete research building that has been constructed in Bethesda, Maryland, several mobile trailer laboratory units, a variable multi-section mobile facility, and a laboratory composed of six trailer units. In addition, several pieces of testing and handling equipment have been designed. All of these items have been built and are currently under evaluation.

Case Number: 00230612 (Cont.)

Dr. McDade could not estimate specific savings realized from his uses of the NASA contamination control technology. He stated, however, that "substantial" savings had occurred and that future efforts would continue to benefit from this information.

GFF:ad
3/26/70

Case Number: 00131324

Concerned with potential contamination resulting from dust particles, the East Coast division of an electronic component manufacturing firm has used information from NASA's "Contamination Control Handbook" in conjunction with its own ideas to establish the necessary procedures and methods for dust control. Use of the handbook developed for the Marshall Space Flight Center has resulted in establishing interim controls and it is also being consulted for more definite dust control and particle collection methods. A company spokesman reported that the handbook has contributed to general monetary and time savings and that the interim measures taken have resulted in improved product reliability and reduced rejection rates.

Subject	Technology Source
Aerovox Corporation Olean, New York 14760 716-372-6611 Contact: N. J. Malick Special Products Manager	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

Aerovox Corporation manufactures a variety of electronic capacitors, condensers, resistors, switches, and components. At its Olean plant, which manufactures ceramic capacitors, the company has been concerned with potential dust particle contamination of the ceramic materials used before raw ceramic reaches the kiln. To solve this problem, company engineers have considered various methods of particle collection and dust control.

The NASA handbook on contamination control is being used by the company's engineers to help determine the best approach for an overall solution to the problem. Certain interim measures have been taken in solving the problem, but more definite procedures and controls are being contemplated. The interim steps taken consist of employing clean room smocks and the use of laminar flow tables as recommended in the NASA handbook. The handbook is also being used as a reference guide in constructing an effective dust collector. Special Products Manager N. J. Malick indicated that, although he could not estimate specific cost reductions, use of the handbook has contributed toward monetary and time savings and has resulted in improved product reliability and reduced rejection rates.

Case Number: 00131324 (Cont.)

Mr. Malick, who does not normally receive NASA Tech Briefs, became aware of the availability of the handbook through a person outside of his organization. He commented that the handbook was "perfectly straight forward" and that he experienced no difficulties using it.

RLB:ad
3/18/70

Case Number: 90728488

The use of NASA-generated technology by engineers at a U.S. Naval Ordnance Station not only saved engineering man-hours, but it also enabled them to demonstrate that requirements imposed on a weapon systems contractor were obtainable and realistic and that a system redesign was not required. The contractor had maintained that the testing requirements imposed by specifications were too rigid and that the test results could not be satisfactorily evaluated. However, the NASA technology on relay testing studies provided insight on testing and evaluating criteria which enabled the engineers to justify the requirements.

Subject	Technology Source
U.S. Naval Ordnance Station 7500 West Roosevelt Road Forest Park, Illinois 312-306-2700 Contact: W. J. Gotch Supervisor	Marshall Space Flight Center Tech Brief: 68-10268, "Vibration Testing and Dynamic Studies of Relays"

At the U.S. Naval Ordnance Station in Forest Park, Illinois, Engineering Supervisor W. J. Gotch is responsible for research and evaluation of ordnance components and materials. Mr. Gotch was recently called upon to evaluate and justify the requirements of a specification which a contractor said were unrealistic. The specification imposed rigid environmental and vibration testing requirements on relays used by the contractor in a classified weapon system.

The NASA information on vibration testing of relays provided testing criteria and gave some precedent on how to evaluate test results. Mr. Gotch was able to use the information to develop convincing arguments which were used in negotiations with the contractor. Although Mr. Gotch could not estimate the savings contributed by his use of the NASA information, he said it did save his department many man-hours in evaluating and justifying the specification requirements. Mr. Gotch also said it enabled him to prevent the cost of redesigning or reprocuring the weapon system since they were able to demonstrate that the specification requirements were obtainable and realistic.

RLB:bh
2/6/70

Case Number: 90829742

The "Contamination Control Handbook," a Marshall Space Flight Center publication, provided a well-known Northeastern manufacturer of advanced electro-optical devices with the information needed to design and implement a particularly sensitive clean room. The handbook also generated time and cost savings and was the principal source for an in-house training manual. Savings attributable to handbook uses are estimated at $5,000 this year and from $5,000 to $10,000 next year.

Subject	Technology Source
Perkin-Elmer Corporation Myra Brook Road Danbury, Connecticut 06810 203-744-4000 Contact: Steve Spratt Training Manager	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

The Administrative Training Manager of the Perkin-Elmer Corporation, Steve Spratt, recently described the NASA "Contamination Control Handbook" as "quite important" and said he refers to it routinely for technological and procedural advice. Because of stringent contractual obligations, Spratt indicated it was necessary to generate and demonstrate a sophisticated clean room capability. The handbook figured importantly in developing this expertise. He estimated his firm saved at least $5,000 during the first year of use and will save an estimated $5,000 to $10,000 during the second year. Use of the handbook also contributed significantly to improvement of existing classified products and processes, to development of new products and processes, and to real-time contamination control room savings.

JK:ad
3/3/70

Case Number: 90829752

A bibliography developed by Marshall Space Flight Center has been used by a chemistry professor at a Midwestern university in his research on the sources of energy transfer from materials subjected to high temperatures. The bibliography of sources containing emissivity and absorptivity data on materials at extremely high temperatures was used by the professor in evaluating the necessity of continuing his research, in determining the objectives of his continued research, and in justifying the need for additional research funds.

Subject	Technology Source
University of Illinois Department of Chemistry Box 4348 Chicago, Illinois 60680 312-663-3161 Contact: Dr. R. P. Burns Assistant Professor	Marshall Space Flight Center Tech Brief: 68-10240, "Properties of Optics at High Temperature and Their Measurement, A Study"

An assistant professor of chemistry at the University of Illinois, Dr. R. P. Burns, is conducting research on high temperature materials with particular emphasis on transparent and opaque materials. In his research, Burns is particularly interested in studying the interaction of molecular beams on surfaces in order to evaluate energy sources and transfer. The results of the research will be the subject of a paper Burns is preparing for publication and also will be used by a research assistant as part of a doctoral dissertation.

Information contained in a NASA bibliography on high temperature optics aided Burns in several ways. Most significantly, it indicated the necessity continuing the research. It also helped him determine what type of laser system could be most efficiently used in his research. Burns estimated he saved approximately $13,000 by using a less sophisticated laser system referred to in the bibliography.

Although Burns was quite complimentary about the information he had received, he said it would have contributed much more to his research

Case Number: 90829752 (Cont.)

if it had included more data on test correlations. Burns remarked, however, that it was a very valuable document since it identified sources and information not otherwise available to him.

RLB:ad
2/4/70

Case Number: 00230520

NASA technology received by a Southern electronics manufacturing company not only enhanced the company's state-of-the-art capability, but it also enabled the company to write specifications on thermal-control paints with a limited amount of research trial and error. The NASA technology, developed by the Jet Propulsion Laboratory, was quite important since the company required thermal-control paints for a spacecraft antenna that would enhance solar reflection because absorption of solar energy would be detrimental to the antenna's operation.

Subject	Technology Source
Radiation, Incorporated P. O. Box 37 Melborne, Florida 32902 305-727-4000 Contact: Dr. B. H. Thrasher Associate Principal Engineer	Jet Propulsion Laboratory Tech Brief: 68-10553, "Structural Thermal- Control Coatings"

Radiation, Inc. primarily manufactures communication and telemetry systems. On one of the company's systems, thermal-control paints were required for a spacecraft antenna that would enhance solar reflection since the absorption of solar energy was detrimental to the successful operation of the system. Dr. Thrasher, Associate Principal Engineer at Radiation, Incorporated, sent for the NASA Technical Support Package on thermal-control coatings to assist in selecting appropriate paints and in preparing required specifications on the paints.

Dr. Thrasher indicated that the NASA technology was quite important because it not only aided in selecting the required paints and writing the specifications, but it also enhanced his company's state-of-the-art capability. Without the NASA technology, Dr. Thrasher said that the company would have had to do much more research on different paints. Although Dr. Thrasher could not estimate the specific monetary and time savings resulting from the availability of the NASA technology, he stated the savings were probably significant.

Company engineers, according to Dr. Thrasher, anticipate using this NASA technology on future programs and feel that the availability of this

Case Number: 00230520 (Cont.)

technology has increased their firm's competitive posture since it has helped to increase their state-of-the-art capabilities.

RLB:ad
3/26/70

Case Number: 91231020

A small Pennsylvania engineering company used circuitry technology developed by the Goddard Space Flight Center in designing a remote controlled receiver system. Use of the information saved two man-weeks of effort and also stimulated other in-house research efforts.

Subject	Technology Source
Locus, Incorporated Box 740 906 West College Avenue State College, Pennsylvania 16801 Contact: Richard F. Erdley Staff Engineer	Goddard Space Flight Center Tech Brief: 67-10447, "Oscillator Circuit Operates as Digitally Controlled Frequency Synthesizer"

Locus, Inc., is a small engineering firm that specializes in RF distribution systems and their components. The company develops and manufactures hardware, and also provides consulting services for major aerospace companies. Richard F. Erdley, Staff Engineer, requested TSP 67-10447, entitled "Oscillator Circuit Operates as Digitally Controlled Frequency Synthesizer," to assist in the design of a remote controlled receiver system. Erdley estimated that the information he used helped his firm save two weeks of effort. He also indicated he has found the document useful for reference purposes when acting as a consultant to firms using Locus systems.

GFF:bh
3/26/70

Case Number: 91231078

The National Fluid Power Association (NFPA), a society of manufacturers of hydraulic components, is relying heavily upon Marshall Space Flight Center's "Contamination Control Handbook" to develop industry-wide standards in response to a quickly changing government marketing environment. The chief engineer of a well-known Midwest filter and seal manufacturer participating in this crash effort stated categorically, "We would have been lost without this document."

Subject	Technology Source
Parker Hannifin Rosaen Filter Division 1776 Nine Mile Road Hazel Park, Michigan 48030 313-566-4778 Contact: Carl A. Brown Chief Engineer	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

Carl A. Brown is chief engineer of Parker Hannifin, one of the 15 member firms belonging to the National Fluid Power Association (NFPA). Brown said he used the NASA "Contamination Control Handbook" to develop NFPA standards for measuring particulate contamination, establishing contamination tolerance levels for hydraulic components, developing contamination sampling methodologies, and conceiving an appropriate fluid power glossary. Recent shifting government contract requirements have forced the association to mount this crash effort to systematically identify and document the theoretical and empirical knowledge and standards of their industry.

According to Brown, use of the handbook required a quantum jump in the expertise of association members, virtually forcing the development of sophisticated capability in contamination control technology.

Association members work closely with Dr. E. C. Fitch of Oklahoma State University, who originally recommended the handbook to them, in a Basic Fluid Power Research Program investigating actual working problems in the fluid power industry. Representative association

Case Number: 91231078

members include Ford Motors, John Deere, International Harvester, Cincinnati Milling Machine Company, and the U.S. Army.

JK:ad
3/4/70

Case Number: 00335912

A number of federally-supported education programs concerned with technology transfer are having important effects in a Florida university. Employing a host of space program devices and concepts, a university professor is helping his students design an innovative scale model "car of the future." Both the Department of Transportation and the Florida State Department have encouraged the professor to develop a full-scale working prototype of the car under their auspices.

Subject

The Florida State University
Industrial Arts Department
Tallahassee, Florida
904-599-3395
Contact: Ernest G. Berger
Assistant Professor

Harold Mehrens, Jr., Education Officer at the Kennedy Space Center, held a series of planning meetings in 1966 designed to stimulate and instruct selected educators in using the increasing body of available space technology information. Professor Ernest G. Berger of Florida State University, who attended these meetings, received from Mehrens an extensive body of descriptive NASA literature on the subject. Berger then applied for and was awarded a grant from the U.S. Office of Education to direct and conduct three consecutive technology transfer training institutes. Seventy teachers and forty-five students attended the institutes. "Search," a chronicle of one of these summer sessions, is available from Mr. John Hoftee, Industrial Arts Chairman, c/o Fletcher Senior High School, Neptune Beach, Florida.

NASA's "Spacemobile," a traveling van designed to demonstrate to junior and senior high school students examples of space science and technology, gave Professor Berger the idea of using a van to demonstrate methods of transferring NASA technology to students, and to make them aware of the technology transfer concept. Berger called his van a "Teckmobile" and presented 5-day demonstrations at various schools in Florida and Georgia.

From these demonstrations he created an undergraduate teacher-training "R & D Methods" course consisting of a review of NASA literature

Case Number: 00335912 (Cont.)

on space program R & D methodology and techniques which assisted his new student-teachers to develop technology transfer course material and instruction booklets. They then devised a suitable school project using this space technology, and presented the project for critical evaluation to a committee consisting of Professor Berger, his associate instructors, and NASA personnel. The expertise and momentum generated by these efforts led the professor to then develop a graduate course in technology transfer, possibly the only such course in the country.

The principal project of the undergraduate course was to research and develop a scale model "car of the future." This model employs a variety of NASA-developed concepts and devices, including honeycomb structure, lexon bubbles, small fluidic controls, a solid state computer, fuel cell propulsion, sealed dry lubricants, retro-fire collision rockets, and miniaturized integrated circuitry.

Although Kennedy Space Center has in the past provided relevant literature, a quarter-scale LEM mock-up, a Pratt and Whitney RL-10 rocket engine mock-up, and other technical assistance, present budgetary constraints have totally eliminated this source of assistance. Professor Berger is enthusiastic over a Lewis Research Center publication titled "Theory of Rocketry," which he said will be used as the basis for a course in rocketry. Berger indicated he also would like to obtain the three-volume NASA Thesaurus (SP-7030) for use in the rocketry course.

JK:bh
3/31/70

Case Number: 90829730

NASA technology on a solid state high voltage pulser circuit design proved to be crucial to a New England electronics company and saved the firm an estimated $1,500 in research and development costs. The circuit design, developed for the Marshall Space Flight Center, was used by the company to overcome problems in the development of a new electronic system. A company spokesman reported that the NASA technology involved an economical circuit configuration which company engineers were able to adapt almost directly to their system with a minimum of development time and cost.

Subject	Technology Source
E. G. & G., Incorporated Eastern Science and Technology Division Crosby Drive Bedford, Massachusetts 01730 617-271-5000 Contact: J. C. Chapman, Ph.D. Scientist	Marshall Space Flight Center Tech Brief: 68-10308, "Solid State High-Voltage Pulser Operates with Low Supply Voltage"

The Eastern Science and Technology Division of E. G. & G., Incorporated concentrates on research and development as applied to the manufacturing of electronic systems. Dr. J. C. Chapman, a scientist in the division, said company engineers were working on a new electronic system design which required a high voltage pulser, trigger generator. After a little checking, they determined that a circuit design developed for NASA could be used in the system.

Although proprietary considerations limited Dr. Chapman's ability to discuss the exact use of the NASA technology, he indicated that the information provided them with an economical high voltage pulser design which they were able to use almost directly. He described the NASA technology as "crucial" since it provided the required circuit design and saved research and development time and effort. Although an exact indicator of the savings was not available, Dr. Chapman estimated that at least $1,500 in time and effort had been saved. He also commented that the NASA technology may be applied to an existing product which could result in additional savings.

Case Number: 90829730 (Cont.)

Dr. Chapman said the NASA information helped increase company engineers' state-of-the-art knowledge since it described a new circuit design; he said they experienced no difficulties in their use of the data.

RLB:ss
3/9/70

Case Number: 00335906

An Eastern electronics firm is developing a Pilot Warning Indicator (PWI) for NASA that will warn pilots of approaching aircraft. The PWI employs an optical technique that operates in the infrared part of the spectrum and detects radiation given off by a xenon strobe light mounted on an approaching airplane. Under clear weather conditions, the PWI is supposed to be operational for three to five miles. Characteristics of PWI devices include low cost, low weight, low power consumption, short range, and warning only. Given these characteristics, the device is expected to cost about $1,000 and be ready for commercial use and sale during 1972.

Subject

Owens-Illinois, Incorporated
Fecker Systems Division
4709 Baum Boulevard
Oakland, Pennsylvania
412-621-3200
Contact: Mel Lowry
Manager of Engineering

According to articles in Aviation Daily (November 19, 1969) and Interavia (March 27, 1968), Fecker Systems Division of Owens-Illinois is developing a Pilot Warning Indicator (PWI) to be used for detecting approaching aircraft. The device will detect radiation from the xenon strobe lights that are presently installed on most large airplanes. These lights give off very strong signals in the infrared range in several narnow bands. One of these signals, transmitted at a wavelength of about one micron, can be detected easily by a silicon detector. Importantly, signals in the infrared range are not as much weakened by the atmosphere as are adjacent wavelengths of the spectrum.

Fecker's device consists of a transparent ball with individual silicon detectors glued to one hemisphere. If the refractive index of the transparent material is properly selected, the light rays striking the ball are focused on the rear surface in positions analogous to the spatial position of the aircraft. Detectors at these positions actuate lights on the pilot's cockpit indicator to warn him of the presence of other aircraft.

Engineering Manager Mel Lowry indicated that Fecker had originally responded to a NASA request for a detecting machine with low cost,

Case Number: 00335906 (Cont.)

low-weight, low power consumption, short range, and warning characteristics. Since the system will operate in the visible part of the spectrum, the xenon strobe lights can be detected without a PWI.

The device is to be sold at a cost of about $1,000. According to Lowry, the price presupposes a production run of 10,000 units. If the demand runs considerably higher than expectations, either because of government purchasing or general acceptance, the unit cost could be lowered. A less expensive and less powerful model may be developed for smaller aircraft at a later date. The present prototype, which will be flight-tested by NASA in April 1970, has a range of three to five miles, depending upon weather conditions, and has the ability to scan an area of one-half hemisphere in front of the aircraft. The production model should be ready for sale, distribution, and installation about 1972.

The biggest problem with the PWI involves the pilot. The PWI may work too well and too often causing the pilot to turn it off. Thus the instrument must be designed to detect only "threat" aircraft. One method for assisting the pilot is to code the strobe lights of the aircraft according to direction or altitude.

Besides the PWI being developed by Fecker, Hughes Aircraft Company and Loral Corporation are working on similar models with their own funds. In addition, another type of PWI using radio frequency techniques with random coding and Dopplar signals is being developed by the Langley Research Center. This device operates on a lower set of frequencies and is scaled for use with existing equipment. All of these devices are to be tested during 1970.

GHP:jd
3/17/70

Case Number: 90526412

Information received from NASA provided some of the mathematical deviations required by scientists in a major West Coast aerospace firm and saved approximately $1,000 in research and development costs. The NASA information concerning digital computer processing of X-ray photos, as developed by the Jet Propulsion Laboratory, applies techniques which are similar to a system being developed by the firm for inspection of printed circuit boards. Although the NASA information was only moderately important to the total scope of the development activity, a company spokesman said it did prove to be quite helpful.

Subject	Technology Source
North American Rockwell Corporation Research Center 1049 Camino Dos Rios Thousand Oaks, California 91360 805-498-4545 Contact: Dr. George Lauer Technical Staff	Jet Propulsion Laboratory Tech Brief: 67-10005, "Digital Computer Processing of X-Ray Photos"

Scientists at the North American Rockwell Corporation Research Center are working on a system of automatic data processing associated with an inspection technique. The system would operate somewhat like the technique developed by the Jet Propulsion Laboratory for digital computer processing of X-ray photos. Dr. George Lauer of the Center said that the system can be used with several different products, but initially it will be applied to the inspection of printed circuit boards. If the system proves economically feasible, it should contribute to improved product reliability.

Dr. Lauer said that the NASA information was quite helpful since it provided some of the mathematical derivations which were required in developing the system. The availability of the information also helped engineers save at least 40 to 50 man-hours of research time which Dr. Lauer estimated was a saving of over $1,000. Dr. Lauer predicted that NASA technology will be used in future research activities, but this involved patents and company proprietary information which he said he was not at liberty to discuss.

RLB:kh
2/2/70

Case Number: 90829482

In order to overcome problems of converting signals received from engine systems to digital data, a New England manufacturer of aircraft control systems has combined its ideas with NASA technology to design a voltage-controlled oscillator which the company expects to use in its existing and new digital control systems. The NASA technology, developed by the Jet Propulsion Laboratory, served as a starting point and as a guide in developing the new oscillator design which helped not only in development but also helped reduce overall research and development time and cost.

Subject	Technology Source
Chandler Evans, Incorporated Charter Oak Boulevard West Hartford, Connecticut 06101 203-236-0651 Contact: Edward F. Gebelein, Jr. Section Head, Engineering	Jet Propulsion Laboratory Tech Brief: 69-10133, "100 MH_Z Voltage-Controlled Oscillator"

Chandler Evans, Incorporated primarily designs and manufactures control systems for aircraft. One such system is a digital control system designed for controlling the fuel system in an aircraft. The system is designed to receive and convert engine system signals to digital data; however, the company has been experiencing problems with the system's capability to convert the signals received to digital data. To overcome this problem, company engineers have combined their ideas with technology received from NASA to develop a voltage-controlled oscillator which they say may do the job.

The voltage-controlled oscillator developed by the company is in the breadboard stage, but the concept has been completely tested and proven. According to the company engineer E. F. Gebelein, the first prototype will be complete in about eight months. The new voltage-controlled oscillator is expected to be used in the company's existing and new digital control systems.

In addition to contributing ideas to the overall design, the NASA technology served as a starting point and as a guide to the company's engineers. Mr. Gebelein said he was very happy with the NASA

Case Number: 90829482 (Cont.)

information. He said that too often the information received is different than expected, but that in this case the Technical Support Package was just the type of information needed.

RLB:ad
3/13/70

Case Number: 91230895

A new adhesive developed for Lewis Research Center for use in cryogenic pressure vessels has been used in the research and development activities of a small West Coast manufacturer of adhesives and potting compounds. The NASA information has been important to the company in developing potential applications for its products.

Subject	Technology Source
Epoxylite Corporation 1428 North Tyler Avenue P.O. Box 3397 South El Monte, California 91733 213-444-9514 Contact: A. L. Cupples Executive Director	Lewis Research Center Tech Brief: 69-10074, "Adhesive for Cryogenic Temperature Application"

Epoxylite Corporation is a small company that manufactures adhesives and potting compounds. Executive Director A. L. Cupples said that Epoxylite had an adhesive for cryogenic structures and that he was interested in obtaining information on the adhesive developed by NASA.

Although Cupples considered his company's specific use of the information to be proprietary, he did say that it helped determine some possible areas of application for the Epoxylite adhesive. It also helped in development activities designed to improve upon their product. The new adhesive is still under development, but some samples have been sent out for evaluation by certain customers. Cupples said that production and marketing of the new adhesive was only about two years away. He said he could not estimate the savings resulting from his use of the NASA information, but he said it contributed toward definite savings since it was important to company activities.

RLB:ad
1/20/70

Case Number: 00231536

A Michigan research laboratory used basic suppression technology developed for Marshall Space Flight Center to help solve a problem encountered during development efforts on a new automatic calibrating device. A company engineer estimated two man-months of effort were saved and a substantial improvement in the performance of the item was realized.

Subject	Technology Source
ITE Imperial Corporation P.O. Box 177 Detroit, Michigan 48232 Contact: Richard J. Scheich Senior Development Engineer	Marshall Space Flight Center Tech Brief: 66-10449, "Basic Suppression Techniques are Evaluated"

The ITE Imperial Corporation Research Laboratory conducts various types of programs to improve the firm's line of motor control equipment. For one of these efforts, Senior Development Engineer Richard J. Scheich was responsible for the development of a new automatic calibrating device using solid state components. After encountering "spiking" problems in the circuits, he requested the NASA TSP "Basic Suppression Techniques are Evaluated." By using some of the suppression techniques described in the TSP, Scheich was able to produce significant performance improvements in the laboratory model of the device. Further modifications in certain very sensitive portions of the apparatus were required to completely eliminate the "spiking." Mr. Scheich said that the information had saved his firm at least two man-months of effort, increased the current awareness of laboratory personnel, and assisted in preparing proposals for additional research work.

GFF:bh
3/26/70

Case Number: 00331988

The research and development center of a large Pennsylvania corporation is presently using NASA technology to support an in-house development program. The information, which was prepared by TRW for the Lewis Research Center, describes new polymers that are particularly adapted for use at higher temperatures. The company research effort is to design a wire insulation for DC motors that are exposed to more external heating than normal. The manager of the group conducting the effort estimates that availability of the technology has already saved three man-months of engineering time. The extent of the total savings will not be known until the research project is completed.

Subject	Technology Source
Research and Development Center Westinghouse Electric Corporation Churchill Boro. Pittsburgh, Pennsylvania 15235 Contact: D. A. Rogers, Jr. Manager, Composite Insulating Materials	Lewis Research Center Tech Brief: 69-10118, "New Rapid-Curing, Stable Polyimide Polymers with High- Temperature Strength and Thermal Stability"

The Research and Development Center of the Westinghouse Electric Corporation is now engaged in an in-house development program for improved DC motors. The effort has the goal of designing units that can withstand higher operating temperatures (180°F). An important part of the project is the development of improved wire insulation materials. Mr. D. A. Rogers, Jr., Manager of Composite Insulating Materials, has the responsibility for that effort. He ordered TSP 69-10118, "New Rapid-Curing, Stable Polyimide Polymers with High-Temperature Strength and Thermal Stability," to learn more about this new resin system. This NASA document was prepared by TRW, Inc., for the Lewis Research Center.

Mr. Rogers reported that the information contained in the TSP was pertinent to the research program that Westinghouse is conducting. At the present time, efforts are concentrated on screening all available materials to see which are suited to meeting the new temperature requirements for the DC motors. Later this year, trade-off studies will be performed on the most promising types. Mr. Rogers expects that the final insulation will consist of a mixture of several materials,

Case Number: 00331988 (Cont.)

one of them possibly the polymer described in the TSP. He also estimated that use of the NASA document has saved three man-months of engineering time. Future savings are completely dependent upon project results and cannot be estimated at this time.

GFF:ad
3/31/70

Case Number: 00231460

A California electronics manufacturing company will use technology developed by a Marshall Space Flight Center contractor to produce a new automatic inspection system. The firm expects to save $25,000 next year because of reduced operating costs. The system is used to perform nondestructive tests of all welded connections on electronic components. This 100% inspection ensures that a reliable product is being manufactured.

Subject	Technology Source
A California Electronics Manufacturing Company Contact: Assistant Manager of Quality Control	Marshall Space Flight Center Tech Brief: 68-10333, "Automatic, Nondestructive Test Monitors In-Process Weld Quality"

A California electronics manufacturing company is producing integrated circuit bodies with various industrial applications. Part of the production process includes a large amount of resistance welding. The normal way to check the quality of the completed welds is to destructively test a representative sample of the connections produced during each manufacturing shift. The Assistant Manager of Quality Control ordered TSP 68-10333, "Automatic, Nondestructive Test Monitors In-Process Weld Quality" to determine whether it might help the company reduce quality control costs.

Members of the Quality Control Department have carefully reviewed the NASA document and have determined that a nondestructive testing technique should be established in their company. Current plans are to install 30 nondestructive testing units in their plant. They predict production costs will be reduced $25,000 next year by using this new inspection technique. Because every weld is automatically checked at the time it is made, a more reliable product also is predicted.

GFF:ad
3/26/70

Case Number: 00131286

Based upon engineering ingenuity and information received from NASA on contamination control, an East Coast pharmaceutical firm plans to construct environmentally controlled work areas which will reduce the dangers in manufacturing potent drugs while increasing production efficiency. Under the current method, employees are required to wear air-supplied protective clothing in work areas where the atmosphere can be contaminated by potent drugs. However, by applying the principles of laminar airflow, as defined in the Marshall Space Flight Center "Contamination Control Handbook," a company manager said that personnel safety can be improved without requiring employees to wear air-supplied protective clothing.

Subject	Technology Source
Ortho Pharmaceutical Corporation Raritan, New Jersey 08869 201-524-0400 Contact: John Colligas, Director Pharmaceutical Manufacturing	Marshall Space Flight Center Tech Brief: 68-10392, "Contamination Control Handbook"

Ortho Pharmaceutical Corporation, a subsidiary of Johnson and Johnson, primarily manufactures pharmaceutical and diagnostic products. Mr. John Colligas, Director of Pharmaceutical Manufacturing, indicated that the company manufactures a potent drug which can contaminate the atmosphere in certain work areas. Personnel safety in these work areas necessitates the wearing of air-supplied protective clothing which Mr. Colligas described as being "like space suits." Although the garment protects employees, it also contributes to production inefficiencies and morale problems since some employees are reluctant to wear the clothing.

To overcome the necessity of wearing the protective clothing, Mr. Colligas said company engineers have developed methods for environmentally controlling potentially dangerous work areas. The method that Mr. Colligas expects to incorporate are based upon information reported in the NASA "Contamination Control Handbook." Although he is not concerned with contamination from airborne particles as such, Mr. Colligas said that the principles applied in laminar flow for removal of airborne particles can be used to control atmospheric contamination created by potent drugs. Mr. Colligas said he expects to use the laminar flow technology in new environmentally controlled work areas to be constructed in about one year.

Case Number: 00131286 (Cont.)

Although Mr. Colligas could not estimate specific cost reductions associated with his use of the NASA information, he said the handbook definitely will help his firm save engineering effort. In addition, he predicted that intangible savings will result from increased production efficiency and improved employee morale.

RLB:ad
3/10/70

APPENDIX B
Technology Transfer Example Files — Background Information

APPENDIX B

EXHIBIT I. CODING SHEET USED IN TECHNOLOGY TRANSFER EXAMPLE FILES RETRIEVAL SYSTEM
(EXPLANATION FOLLOWS ON EXHIBIT II)

76 77 78 79 80
PATT Case Number

1 2 3 4
TEF Control Number

5 6 7 8 9 10 11 12
Document Number

13
Program Office

14
Originating Organization

15 16
NASA Center

17
Availability of Visual Aids

File Information | Case Information

18 19 20
Last Summary Write up Date

21
Last Testimony Date

22
Patent, License Waiver Status

23 24 25
Type of Technology
NASA STAR

26
Source of Lead or Documented Example

27 28
Transfer Mechanism

29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44
Organization Name or Individual

45 46
SIC

47
Size

48 49 50 51 52
Zip Code

53 54 55
Last Telephone Interview Date

56 57 58
Follow-up Date Required

59
Actual Transfer

60
Potential Transfer

61
Type of Economic Benefit

62
Time Span of Economic Benefit

63
Actual Savings

64
Actual Sales

65
Potential Cost Savings

66
Potential Sales

67 68 69 70 71 72 73 74
Application Areas

75
Public Interest Sub-Categories of Application Areas

67-68 _____
_____
69-70 _____
_____
71-72 _____
_____
73-74 _____
_____

APPENDIX B

EXHIBIT II. BACKGROUND INFORMATION FOR CODING SHEET

COLUMN

1-4 TRANSFER EXAMPLE FILE NUMBER

5-12 TECH BRIEF OR SPECIAL PUBLICATION NUMBER

13 ORIGIN OF TECHNOLOGY

Program Office

0 Unknown
1 OMSF - KSC, MSC, MSFC
2 OART - ARC, ERC, FRC, LARC, LERC, SNPO
3 OSSA - GSFC, WS, JPL
4 OTDA
5 Other

14 ORIGIN OF TECHNOLOGY

Originating Organization

0 Unknown
1 NASA Contractor
2 NASA In-House
3 NASA Employee (Private)
4 AEC
5 DOD
6 Other Government
7 Other Contractors
8 Other

15-16 ORIGIN OF TECHNOLOGY

NASA Center

00 None
01 Unknown
02 ARC
03 ERC
04 FRC
05 GSFC
06 HQ
07 KSC
08 LARC
09 LERC
10 MSC
11 MSFC
12 NAPO (JPL)
13 SNPO
14 WS
15 Other

17 AVAILABILITY OF VISUAL AIDS
(Photos, Slides, Product Literature, Samples)

0 Unknown
1 None Available
2 Available from NASA Headquarters
3 Available from NASA Centers
4 Available from PATT
5 Available from Company
6 Available, but Source Unknown

18-20 Date of last DRI or NASA summary

21 LAST USED IN OTU TESTIMONY

1 Not Used
2 Used Before FY 1970
3 FY 1970
4 FY 1971
5 FY 1972
6 FY 1973
7 FY 1974
8 FY 1975

22 PATENT, LICENSE & WAIVER STATUS

0 Unknown
1 No Patent Involved
2 Waiver
3 Waiver and Subsequent License
4 License
5 Rights given to NASA employee
6 Rights given to NASA employee and subsequent license
7 Patent action under consideration
8 Other

23 TYPE OF TECHNOLOGY (If Tech Brief is not involved, choose closest category)

NASA Code

0 Systems Management, Analysis, Integration
1 Electronic/Electrical: Includes components, circuits and hardware.
2 Electronic/Electrical Systems: Includes equipment and systems such as radar, guidance and control, and power generation.
3 Physical Sciences: Includes optics, sonics, heat and mass transfer, nuclear science and technology, goesciences, and aerosciences.
4 Materials/Chemistry: Includes material properties and descriptions of metals and non-metals; chemical analysis and equipment.
5 Life Sciences: Includes biological sciences, medical instrumentation, and behavioral sciences.
6 Mechanics: Includes analytical methods, systems, safety, and maintenance engineering.
7 Machinery, Equipment, and Tools: Includes machine tools, pumps and compressors, valves, hydraulic/pneumatic equipment, jigs and fixtures.
8 Fabrication Technology: Includes molding and casting, adhesive bonding, welding, brazing, and electroplating.
9 Computer Programs: Includes software, mathematical programs, numerical control, and computer system techniques.

24-25 STAR CODE

01 Aerodynamics
02 Aircraft
03 Auxiliary Systems
04 Biosciences
05 Biotechnology
06 Chemistry
07 Communications
08 Computers
09 Electronic Equipment
10 Electronics
11 Facilities, Research & Support
12 Fluid Mechanics
13 Geophysics
14 Instrumentation & Photography
15 Machine Elements & Processes
16 Masers
17 Materials, Metallic
18 Materials, Non-Metallic
19 Mathematics
20 Meteorology
21 Navigation
22 Nuclear Engineering
23 Physics, General
24 Physics, Atomic, Molecular & Nuclear
25 Physics, Plasma
26 Physics, Solid State
27 Propellants
28 Propulsion Systems
29 Space Radiation
30 Space Sciences
31 Space Vehicles
32 Structural Mechanics
33 Thermodynamics & Combustion
34 General

Unless File Contains Documentation by PATT or Another NASA Agency, No Further Coding Necessary Except Follow-Up Date

26 SOURCE OF LEAD OR DOCUMENTED EXAMPLE

0 Unknown
1 Tech Brief - TSP
2 RDC's
3 BATeams
4 TATeams
5 Other TUD
6 TUO's at Centers
7 General Counsel/I. C. B.
8 Clippings
9 Other

27-28 TRANSFER MECHANISM

01 ARAC
02 KASC
03 NERAC
04 NCSTRC
05 TAC
06 WESRAC
07 TUSC
08 Tech Brief-TSP
09 BATeam
10 TATeam
11 Other NASA Publications
12 COSMIC
13 Other TUD Channels
14 TUO Involvement
15 Seminar, Colloquium, Conference etc.
16 Personal Contacts
17 Reports
18 Professional or Trade Press
19 SBA
20 Supplier Representative, Catalogs, Products, Etc.
21 Original Contractor, Developer/Inventor
22 Other (Former AEC Transfer, Etc.)

29-44 NAME OF REQUESTER ORGANIZATION OR INDIVIDUAL

45-46 REQUESTER'S STANDARD INDUSTRIAL CLASSIFICATION

47 REQUESTER'S ORGANIZATIONAL SIZE

1 1-10
2 11-50
3 51-100
4 101-500
5 501-1,000
6 1,001-5,000
7 5,001-10,000
8 10,001 or more
9 unknown

48-52 REQUESTER'S ZIP CODE

53-55 DATE OF LAST TELEPHONE INTERVIEW

56-58 FOLLOW-UP DATE REQUIRED

999 Reported by another NASA agency, follow-up required but should be done through agency.

59 TYPE OF ACTUAL TRANSFER

0 None Reported
1 Development of New Product
2 Development of New Material
3 Development of New Process or Technique
4 Improvement of Existing Product
5 Improvement of Existing Material
6 Improvement of Existing Process or Technique
7 Stimulation of Basic or Applied Research
8 New Application for Existing Product, Process or Material
9 Other

60 TYPE OF POTENTIAL TRANSFER

0 None Reported
1 Development of New Product
2 Development of New Material
3 Development of New Process or Technique
4 Improvement of Existing Product
5 Improvement of Existing Material
6 Improvement of Existing Process or Technique
7 Stimulation of Basic or Applied Research
8 New Application for Existing Product, Process or Material
9 Other

61 TYPE OF ECONOMIC BENEFITS

0 None Reported
1 Cost Savings
2 Sales
3 Other Economic Benefits
4 Cost Savings and Sales
5 Cost Savings and Other Economic Benefits
6 Sales and Other Economic Benefits
7 Cost Savings, Sales, and Other Economic Benefits

62 TIME SPAN OF ECONOMIC BENEFITS

0 None Reported
1 Past
2 Present (Continuing from Past into Future)
3 Future

63 ACTUAL SAVINGS (Time Savings included at $10/Hr)

0 None Reported
1 Not Measurable
2 $1 to $1,000
3 $1,001 to $5,000
4 $5,001 to $10,000
5 $10,001 to $50,000
6 $50,001 to $100,000
7 $100,001 to $500,000
8 $500,001 to $1,000,000
9 $1,000,001 & over

64 ACTUAL SALES

0 None Reported
1 Not Measurable
2 $1 to $5,000
3 $5,001 to $10,000
4 $10,001 to $50,000
5 $50,001 to $100,000
6 $100,001 to $500,000
7 $500,001 to $1,000,000
8 $1,000,001 & over

65 POTENTIAL COST SAVINGS
(Potential Time Savings Included At $10/Hr)

0 None Reported
1 Not Measurable
2 $1 to $1,000
3 $1,001 to $5,000
4 $5,001 to $10,000
5 $10,001 to $50,000
6 $50,001 to $100,000
7 $100,001 to $500,000
8 $500,001 to $1,000,000
9 $1,000,001 & over

66 POTENTIAL SALES

0 None
1 Not Measurable
2 $1 to $5,000
3 $5,001 to $10,000
4 $10,001 to $50,000
5 $50,001 to $100,000
6 $100,001 to $500,000
7 $500,001 to $1,000,000
8 $1,000,001 & over

67-74 APPLICATION AREAS (See Exhibit III)

75 PUBLIC INTEREST

0 No Transfer or Possibility of Transfer
1 Good Example
2 Secondary Example
3 Potential Transfer Only

76-80 PATT CASE NUMBER

APPENDIX B

EXHIBIT III. TECHNOLOGY TRANSFER EXAMPLE APPLICATION AREA

01 Astronomy
02 Automation
03 Administration
- Accounting
- Finance
- Management
- Marketing
- Production

04 Biotechnology
05 Biosciences
06 Chemistry
07 Clothing
08 Computers/EDP
- Data
- Documentation
- Hardware
- Programming
- Software
- Systems

09 Criminalistics and Law Enforcement
10 Cryogenics
11 Earth Sciences--Non-Satellite
- Cartography
- Drilling and boring
- Geodesy
- Geography
- Geology, crystallography, economic, mineralogy, mining, petrograph, seismology, stratigraphy
- Geophysics and geochemistry
- Hydrology and limnology
- Meterology and climatology
- Soil mechanics

12 Education
- Article preparation
- Increase current awareness, state-of-the-art
- Languages
- Lectures, seminars, colloquium
- Proposal preparation
- Reference, text, handbook manual, materials, teaching, training

13 Energy Absorption, Conversion, Storage and Transmission
- Batteries
- Conveying
- Fuel Cells
- Hoisting
- Hydraulics
- Noise
- Pneumatics
- Shock
- Vibration

14 Engineering, Aeronautical
15 Engineering, Chemical
16 Engineering, Civil
17 Engineering, Electrical
18 Engineering, Mechanical
19 Engineering, Other
- Agriculture
- Human
- Industrial
- Marine
- Metallurgical
- Mining
- Municipal
- Nuclear
- Railroad
- Systems

20 Engines and Fuels
21 Environmental--Non-Satellite (see Earth Sciences)
- Acoustic, pollution, noise abatement technology
- Air pollution technology
- Conservation and recreation
- Cost benefit analysis
- Ecology--ecosystem
- Environmental planning and development
- Public health and hygiene
- Radiation and isotopic pollution technology
- Resources management, planning and development (forest, land, sea, water, air energy, mineral, wild-life, fish)
- Soil pollution, erosion, conservation
- Solid waste pollution, disposal, transformation technology
- Thermal pollution technology
- Water pollution technology

22 Environmental Control Systems (ECS)
23 Fatigue, Stress, Strain Technology
- Instrumentation
- Methodology
- Processes
- Testing

24 Food Packaging, Processing Technology
25 Home Economics
- Foods
- Housewares
- Safety
- Textiles

26 Housing
- Construction technology
- Construction materials
- Construction systems

27 International Technology Transfer
28 Life Support Systems
29 Lubrication
- Lubricants
- Bearings
- Bushings
- Journals
- Sleeves

30 Machine Elements, Equipment, Tools, Processes
31 Management and Information Systems
- Planning
- Retrieval technology
- Storage programming
- Systems analysis
- Systems integration
- Systems management
- Theory

32 Materials and Fabrication Technology
- Ablation
- Absorbtion
- Alodizing
- Anodizing
- Bonding
- Brazing
- Casting
- Ceramics
- Cladding
- Coating
- Compositing
- Elastomers
- Encapsulating
- Enveloping
- Etching
- Fasteners
- Explosives and propellants
- Filming

32 Materials and Fabrication Technology (Cont.)

- Foaming
- Fogging
- Forming
- Grinding
- Hardening
- Honeycombing
- Impregnating
- Induction
- Irradiating
- Joining
- Laminating
- Matrixing
- Modulizing
- Molding
- Plating
- Plastics
- Polishing
- Reinforcing
- Sandwiching
- Sintering
- Soldering
- Spinning
- Swaging
- Tooling
- Welding

33 Metallurgy, Metalwork

34 Miniaturization

35 National Security

36 Nondestructive Testing

37 Oceanography

38 Packaging Technology

39 Physics

- Astro-
- Atomic
- Bio-
- General
- Plasma
- Solid State
- Space

40 Planning

- Airport
- City
- General

41 Public Health

42 Quality Control Systems

- Reliability

43 Recreation

44 Safety

- Aviation
- Automotive
- Marine
- Mine
- Rail

45 Satellite Technology (see Physics, Earth Sciences, Environmental)
- Agriculture, crops
- Astronomy
- Broadcasting
- Cartography
- Climatology, weather control and observation
- Economic analysis
- Forestry
- Geodesy, gravimetric, geometric
- Geography, cultural resources
- Geology, mineral resources
- Hydrology, water resources and pollution
- Meteorology, air pollution
- Navigation and traffic control
- Oceanography
- Point to point communication
- Remoting sensing, data, telemetry and retrieval systems
- Weather modification

46 Testing Equipment, Systems, Theory

47 Transportation
- Aviation
- Automotive
- Marine
- Rail

48 Urban Analysis, Systems, Problems, Planning

APPENDIX B

EXHIBIT IV. TECHNOLOGY TRANSFER EXAMPLE FILES CONTROL SHEET

File No.	Title-(Brief Description of Technology)	Relates to File No.	Document No. or Other	Origin of Technology (NASA Center)	Transfer Mechanism*	Date of Latest Summary	Used in Congressional Testimony		No of Documented Cases		Transfer**	License and Waiver Status	Availability of Product Literature and Visuals
							Primary	Supplm.	PATT	Other			

* Transfer mechanism refers to the means by which users of the technology were made aware of its existence. Examples include Tech Briefs, magazine stories, RDC's, and BATeams.

** This column is intended to indicate whether or not there is at least one documented transfer in the file. In the future, new files will be created only after the documentation of a transfer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